September

25 cents

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

THE SLOT MACHINE RADIO

See Page 442

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Let me send you Free, this big package of "Vital Facts" showing what "Cooke Trained Men" earn, the big opportunities Electricity offers and how you, too, can earn $3,500 to $10,000 a year. The coupon will bring it Free.

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My new $45.00 Radio Course, just completed given Free when you enroll for the Electrical Course. Two courses for the price of one. Two professions open to you.

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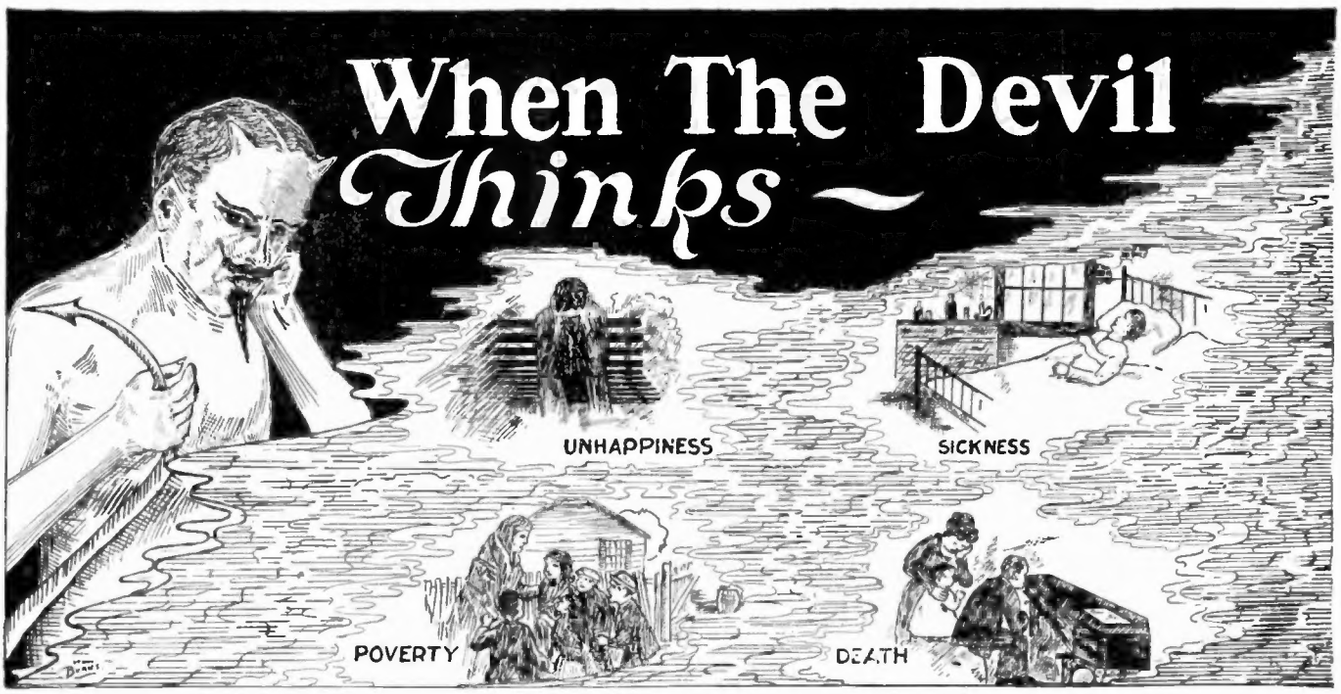

If the Devil Wished to Serve You the Very Worst Possible Turn, He Could Ask Nothing More Than an Opportunity to Do Your Thinking for You

IN that way he could quickly rob you of your health, destroy your prospects of success, and reduce you to poverty, cheat you of love, plunge you into unhappiness, and send you down prematurely to the grave. He would not have to think vicious or immoral thoughts in order to do these things, but merely the *wrong kind* of thoughts.

You may believe in the existence of a personal devil, or you may not. If not, you at least realize that the devil is an allegorical personification of evil. Regardless of your beliefs in this respect, it is solemnly and terribly true that

You May Play the Devil

yourself by thoughts and stages of mind that will be just as destructive of your health, success and happiness as any thoughts that a personal devil might think for you. If you are not abundantly well, successful and happy, you are playing the devil by your way of thinking.

On the other hand, it is easily within your power to assume a method of thought and an attitude of mind that will make you free from disease, failure, disappointment and unhappiness, and that will bring you into possession of whatsoever things you desire—money, health, success, honor, renewed youth, love and happiness.

A wonderful new thing has happened in the world. The great physicians and psychologists of modern science have found that each human being has within him an inexhaustible supply of wisdom and power, and that he can easily draw upon this supply for the destruction of everything he does not want, and for the acquirement of everything he does want. Tens of thousands of men and women have already accomplished these things.

Although my time is largely taken up by my duties as one of the judges of the highest and most important trial courts in my state, I have made an humble contribution toward this great discovery, and you may have heard of me through some of my writings or lectures.

The Liberating Truth Is Free

REGARDLESS of whether you have ever heard of me or not, I have written a personal message for you, which I will be glad to send postpaid and free of charge. It is entitled "Realization." It will introduce you to your own really wonderful self, tell you all about your indwelling wisdom and power, and set your feet upon the way of success, health, love, liberty and happiness. The truth contained in this message has brought me such rich blessings that I feel I ought to tell others about it, and I set aside a few hundred dollars each month for that purpose. Remember, it is

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Jacksonville, Florida

DANIEL A. SIMMONS,
105 Law Exchange Building, Jacksonville, Fla.

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Whole No. 113

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FORMERLY

ELECTRICAL EXPERIMENTER

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Table of Contents for September

POPULAR SCIENTIFIC ARTICLES

THE SLOT-MACHINE RADIO. (See article page 442) ..... Front Cover
From a painting by Howard V. Brown
EDITORIAL 427
By H. Gernsback
ANALYSIS OF THE KISS 428
By Joseph H. Kraus, Staff Medical Expert
FLOWERS EVERLASTING 429
SOUND WAVE MEASURES OCEAN DEPTHS 430
By H. Winfield Secor
HOW EXPERTS IDENTIFY DISCHARGED BULLETS. 431
GIANT TRIPLANE CARRIES THIRTY PASSENGERS. 432
FIND LOST RADIUM IN AN ASH PILE 433
DR. HACKENSAW'S SECRETS, NO. 8, SECRET OF ELECTRICAL TRANSMISSION 434
By Clement Fezandié
RESTORING THE MOON 435
By Burnie L. Bevill
THE END OF THE WORLD—HOW SOON? 436
By Ivan L. Smith
PERSPECTIVE MOTION PICTURES 438
INSTRUCTIVE "MOVIES" SHOW UNIVERSE 440
AUTOMATIC BRAKE CONTROL FOR MOTOR CARS. 441
By H. H. Dunn
AUTOMATIC BOOK VENDORS 441
By Dr. Alfred Gradenwitz
THE SLOT-MACHINE RADIO 442
By H. Gernsback, Member of American Physical Society
MOTION PICTURES IN NATURAL COLORS 443
BALSA WOOD ICELESS CONTAINERS 444
FLYING AROUND WORLD IN TWENTY-FOUR HOURS 444
OF WHAT ARE WE MADE? 445
METALLIC MODEL OF THE SPINE 445
GAS PRODUCER FOR AUTOS 446
By E. H. Lemonon
WHY THE SMOOTH GOLF BALL WON'T FLY STRAIGHT 447
By P. A. Vaile, Expert on Golf
MISCELLANEOUS NEW DEVICES 448-449
HOW BONES GROW 450
By C. M. Lancaster, D. C., Ph. C.
A SUBSTITUTE FOR WOOD 451
By Persis Bingham
A BICYCLE CANOE 452
SCIENTIFIC PROBLEMS AND PUZZLES 453
By Ernest K. Chapin

PRIZE CONTESTS

MOTOR HINTS—$50.00 IN PRIZES 454
"COMBINATION" PRIZE CONTEST—$50.00 IN PRIZES 455
HOW-TO-MAKE-IT DEPARTMENT—$30.00 IN PRIZES 462
"CLOTHES-PIN" CONTEST AWARDS 464
DESCRIPTION OF SET—By Fifth Prize Winner in $300.00 Radio Receiving Set Contest 471

AUTOMOBILES

AUTOMATIC BRAKE CONTROL FOR MOTOR CARS.. 441
By H. H. Dunn
GAS PRODUCER FOR AUTOS 446
By E. H. Lemonon
MACHINE MILLS, DRILLS AND GRINDS 448
By Allen P. Child
MOTOR HINTS—$50.00 IN PRIZES 454
"COMBINATION" PRIZE CONTEST (INCLUDING MOTOR CAR NOVELTIES) 455

ELECTRICITY

SOUND WAVE MEASURES OCEAN DEPTHS 430
By H. Winfield Secor
DR. HACKENSAW'S SECRETS, NO. 8, SECRET OF ELECTRICAL TRANSMISSION 434
By Clement Fezandié
RESTORING THE MOON 435
By Burnie L. Bevill
AUTOMATIC BRAKE CONTROL FOR MOTOR CARS. 441
By H. H. Dunn
DIRECT CURRENT BELL TRANSFORMER 449
MOTOR HINTS—$50.00 IN PRIZES. (Electrical Ideas for the Motor Car.) 454
HOW-TO-MAKE-IT DEPARTMENT—$30.00 IN PRIZES 462
LATEST PATENTS 476
THE ORACLE—QUESTION AND ANSWER 477

RADIO ARTICLES

WHO DISCOVERED RADIO? 465
By A. P. Peck
RADIO OUTFIT IN PICKLE BOTTLE 466
By Edgar L. Eisenstadt
TIKKER RECEPTION OF C. W. 467
CHOPPING BOWL LOUD-TALKER 467
RADIO CONCERTS FROM A LAMP SOCKET 468
By A. P. Peck
FIVE STAGE AMPLIFIER ON 110 VOLTS A. C. 469
RADIO FOR THE BEGINNER 470
By Armstrong Perry
SIMPLEST RADIOPHONE RECEIVER 471
By Frank Copeman
RADIO BROADCAST, UP-TO-DATE 472
PHOTOS OF BROADCASTING STATIONS 474
RADIO ORACLE 475

CHEMISTRY

OF WHAT ARE WE MADE? 445
A SUBSTITUTE FOR WOOD 451
By Persis Bingham
DENATURED ALCOHOL BLAMED FOR DEATHS 452
PRACTICAL CHEMICAL EXPERIMENTS—Paper No. 5 —Qualitative Analysis 456
By Prof. Floyd L. Darrow
SIMPLE CHEMICAL LABORATORY APPARATUS 461
By Raymond B. Wailes
FIREWORK MAKING FOR AMATEURS 463
By Raymond B. Wailes

CONSTRUCTOR ARTICLES

MAGIC WITH A CONICAL MIRROR 458
By Juan Camps Campins
MERRY-GO-ROUND 459
HOW I BUILT A SMALL SPEED CAMERA 460
By Frank M. Blackwell
SIMPLE CHEMICAL LABORATORY APPARATUS 461
By Raymond B. Wailes

ASTRONOMY

THE END OF THE WORLD—HOW SOON? 436
By Ivan L. Smith

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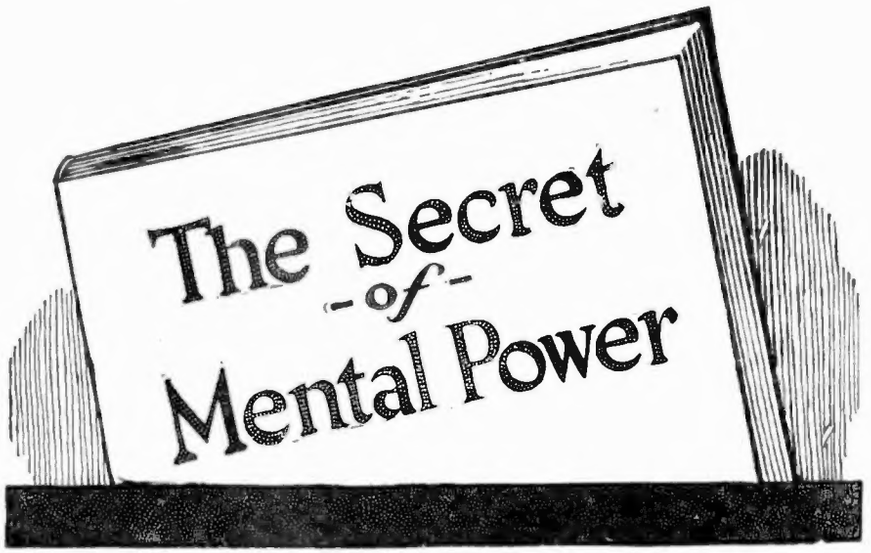
A practical system of constructive thinking that brings business and personal achievement.



"Why do so many men never amount to anything? Because they don't think."
—Edison.

MARK TWAIN once said that the average man didn't make much use of his head except for the purpose of keeping his necktie from slipping off.

And Prof. William James claimed that the average man uses only about a *tenth* part of his brain.

And Thomas Edison states emphatically that most men never amount to much because they don't *think*.

How about you? Are you using *your* head simply as a scarf-retainer? Are you using only 10% of *your* brain? Are you sitting, discouraged and discontented, at the foot of the ladder simply because you don't *think*?

It will pay you to find out.

Mind is the measure of every man. *Mental* power—not *physical* power—wins business battles and builds bank accounts.

The man with *brains* to sell fixes his own price, but the man who brings only *brawn* to market must be satisfied with the lowest wage that brute force brings.

In every age, in every clime and in every field of human endeavor the *trained thinker* wins where the *thoughtless toiler* fails.

Twain, James, Edison, Roosevelt, Rockefeller, Schwab, Carnegie, Woolworth, Wanamaker, Morgan, Hill, Harriman, Ford, Marconi, the Wright brothers and all other successful men reached their goals not because they knew how to use their *muscles* but because they knew how to use their *minds*. Does anybody doubt this? Isn't it admitted by all? Doesn't every one with "brains enough to grease a gimlet" *know* that it's true?

Only One Road to Success

Yes, indeed, there is only *one* road that leads to success and that is the *mental* road. If you expect to accomplish anything worth while by any other method than the *development* and *use* of your mental faculties, you are simply deceiving yourself. And the biggest fool in the world is the man who fools himself.

A recent magazine article states that intelligence tests in this country disclose the deplorable fact that 83% of the people are morons. You won't find the word "moron" in many dictionaries. It means a person with the mental development of a normal fourteen-year-old child.

Is it any wonder why so few people achieve any considerable success in life, when such an enormous percentage of them are so lacking in mental power? Such people have no more chance in competition with trained minds than a midget has to lick Jack Dempsey.

And isn't it simply absurd, when you stop to think about it, that most people are striving for success and yet they are doing absolutely nothing to strengthen and develop their *minds*, which is the *only* part of them with which they can ever hope to win success.

The principal reason that the trained *thinker* gets ahead is because he has so little competition.

The *unthinking* toiler works hard for small pay because almost anyone can do his work.

What are *you* doing—as the days go by—to develop *your* mind? Are you more efficient mentally than you were a month ago—or a year ago? If not, you are standing still. You haven't even started on the road that leads to *bigger* and *better* living.

Missing Success by a Hair's Breadth

The difference between *success* and *failure* is often but the breadth of a hair.

The man who is making *twice* as much as you are has nowhere near *twice* the intellectual ability. The man who enjoys an income of $10,000 a year is not *five* times the mental superior of the man who receives only $2,000.

Get this FREE BOOK

If You Are Interested in Learning

How to think like an arrow.
How to compel attention.
How to master important problems.
How to overcome fear and worry.
How to "tune up" your mental motor.
How to develop new methods.
How to originate new ideas.
How to learn quickly and easily.
How to attract valuable friends.
How to have more time for play.
How to out-think the average man.
How to make your mind a mental mazda.
How to stop thinking in circles.

Thousands upon thousands of earnest, aspiring men are *almost* successful. But in this connection a miss is as *bad* as a mile.

With just a little more *mental* force—with a slightly better trained *mind*—with a little clearer knowledge of *right* thinking—hundreds of men who are now struggling along in the Poor-Pay Army—footsore and weary—would immediately find themselves equipped to command from *two* to *ten* times their present incomes.

Probably the man who makes $1,000 a month is only 10% to 20% better trained mentally than the man who is trying to make both ends meet on $100 a month. This is a *fact*. And it should be a most *encouraging* fact to every man who wants to *be somebody* and *get somewhere*.

The greatest thinkers the world has ever known have hardly more than scratched the surface of their latent mental powers.

Improve your mental power only 10% and you will *multiply* your earning capacity.

Get This New Book

We have just published a new book—*The Secret of Mental Power*. We will gladly send you a copy upon request, with our compliments and good wishes. And we want to state—as forcefully as we know how—that you will find it one of the most interesting and mind-spurring books you ever read.

If you had to quit work for a month in order to get and read this book, it would probably be one of the most profitable months you ever spent. But you don't have to do that. It takes but an *instant* to sign the coupon. You get the book for *nothing*. And you can read it in *twenty minutes*, as it is a small book of 32 pages and 16 illustrations.

Send for a copy of this book today. It tells about the most practical, common-sense system of constructive thinking—the easiest and quickest method of mind-building ever discovered—the secret developing mental power in a way that is as fascinating as a game.

This book shows you the difference between *disconnected, irrational, faulty* thinking and *coordinated, normal, true* thinking.

It shows how you can tell by a man's appearance whether he is a *true* thinker or a *faulty* thinker.

It shows how a *wrong* thought produces a *wrong* action that brings a *wrong* result. And how a *right* thought brings a *right* action that can bring only a *right* result.

It shows the immediate and favorable result of *virile, constructive* thinking and the disastrous results of *flabby, impotent, haphazard* thinking.

In other words it gives you the solution of correct thought processes, which is the only secret of mental power.

Now Is the Time

Send for *The Secret of Mental Power* now. Do not delay. Do not put it off. Tomorrow you may forget all about it. And the loss will be yours, not ours. For although we have printed an edition of 20,000 copies, we do not expect to have a single one left at the end of thirty days. They are going—and going *fast*. Therefore act at once, for as Sophocles so truly said, "Heaven never helps the man who will not *act*."

Don't let the fact that you can get this book easily and at no cost deter you from sending for it or cause you to make the fatal mistake of undervaluing it.

There is, of course, no way of judging in advance how immensely valuable this little book may be to you. But by waking you up mentally—by showing you how to think straight—by showing you an interesting way to build mind power—it will convincingly prove to you that it is one of the most valuable messages that ever reached your mind, and that in taking advantage of this free offer you took a wise and positive step toward greater *mental* power, which is the *only* power that brings success.

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"Thinkers act while sluggards sleep."

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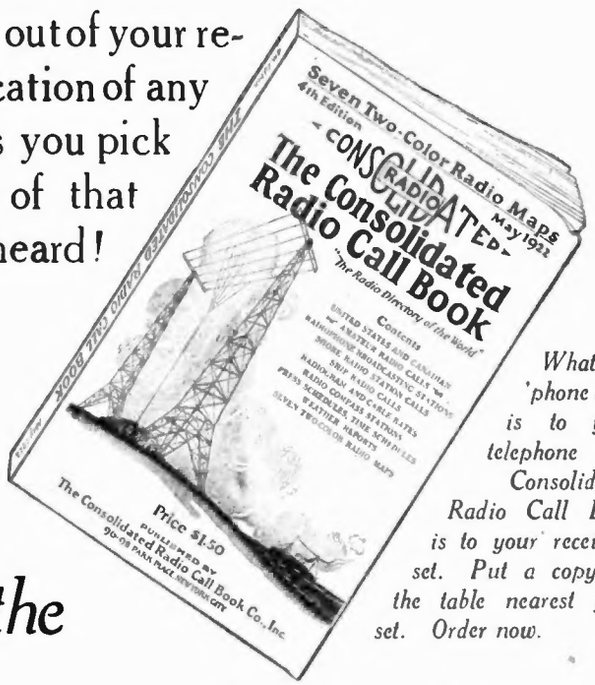

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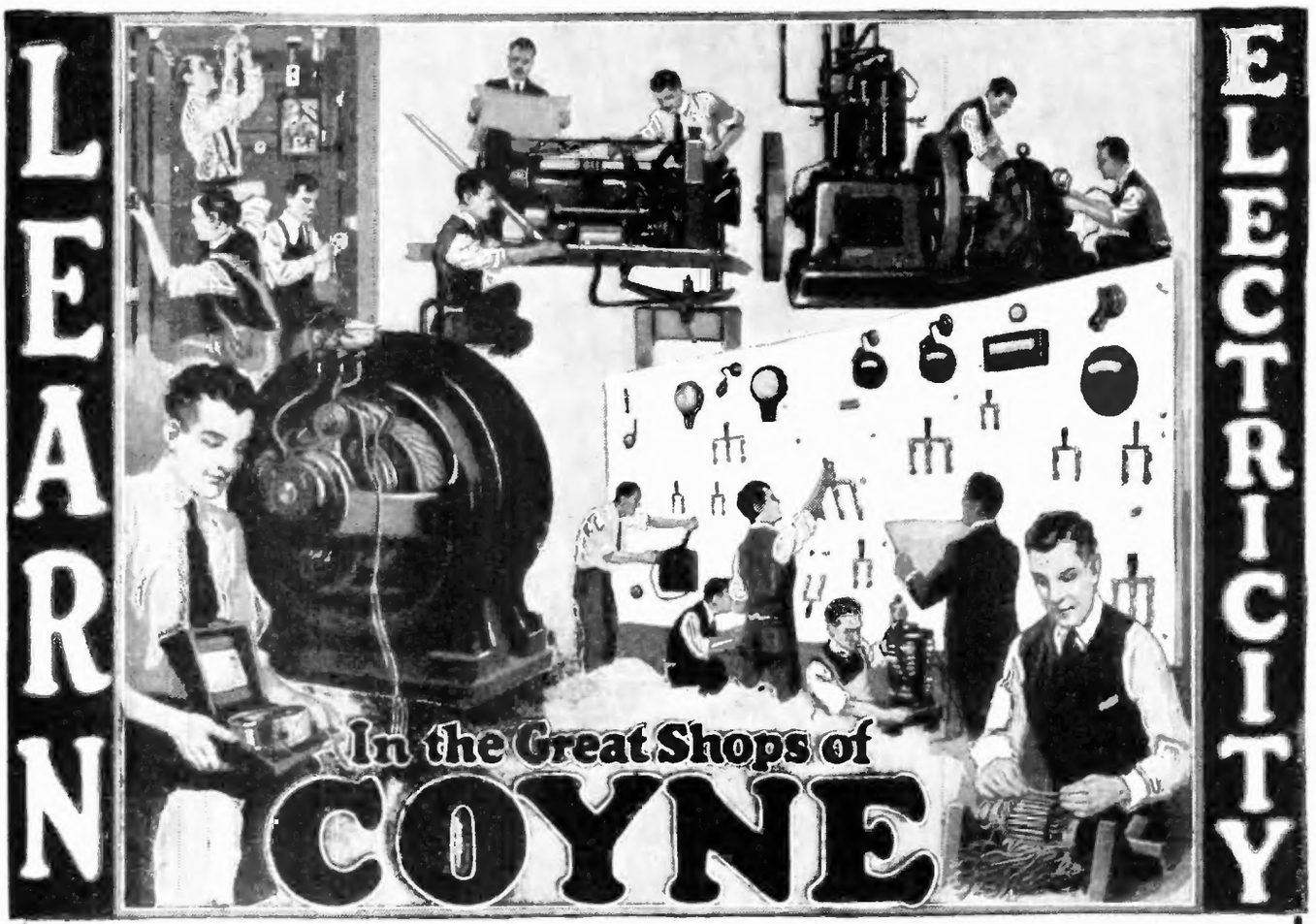

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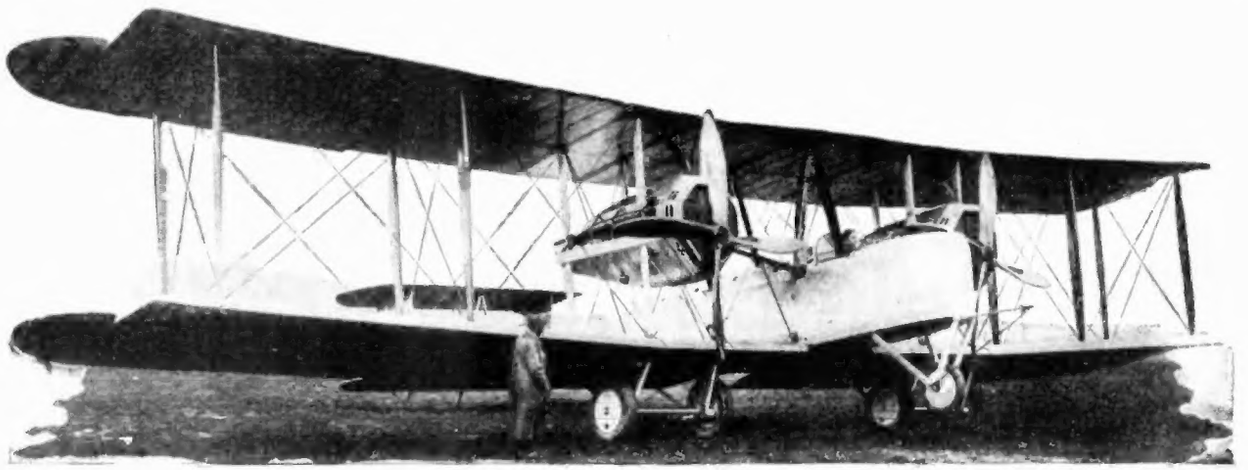

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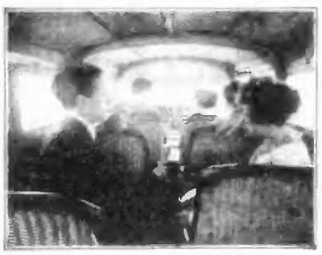

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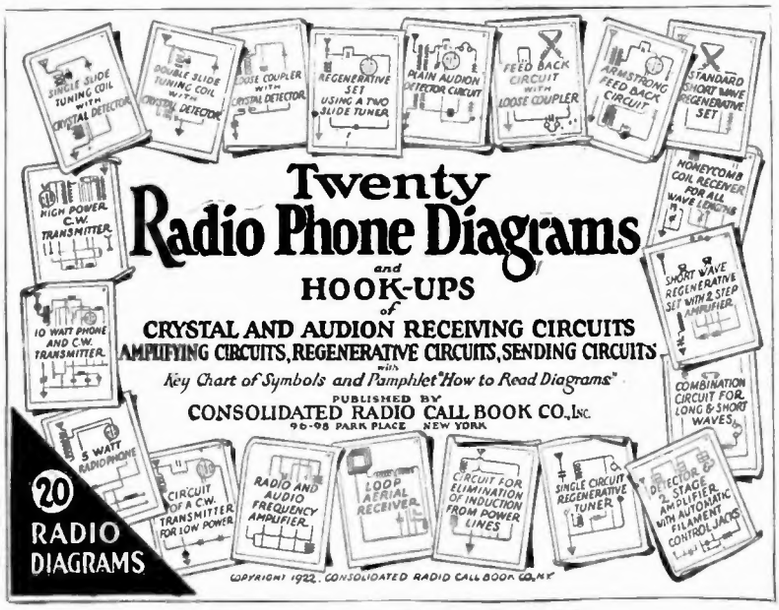

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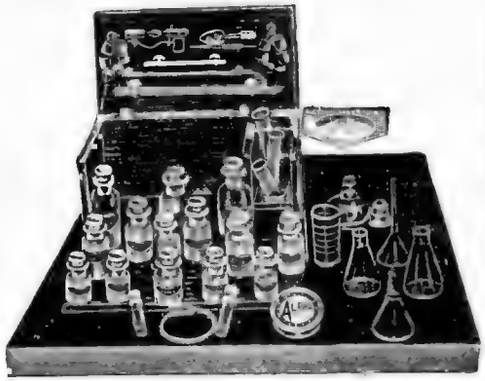

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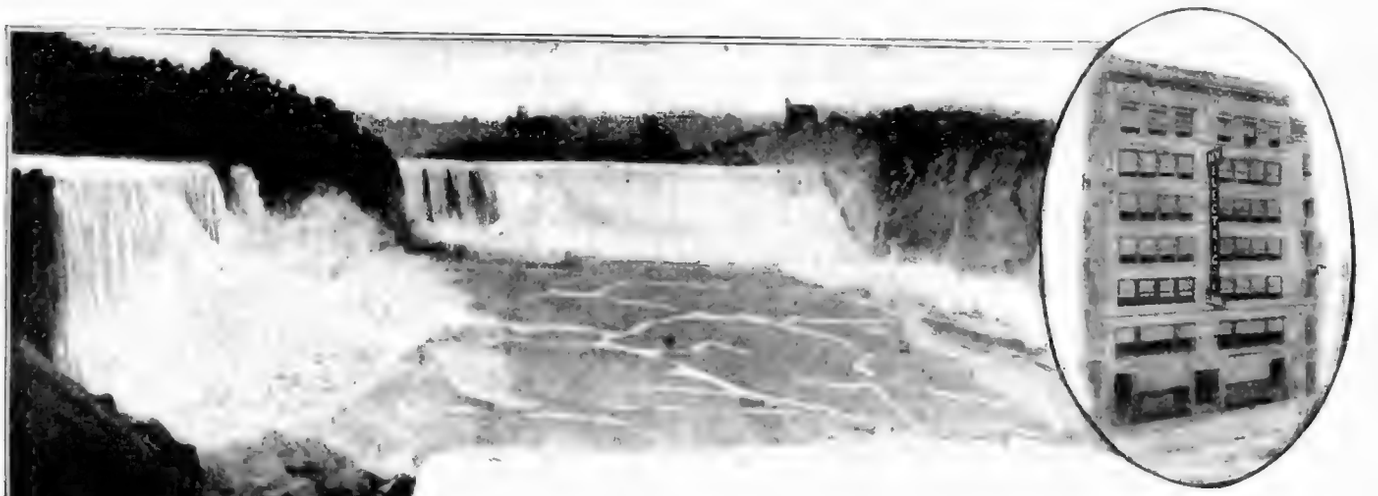

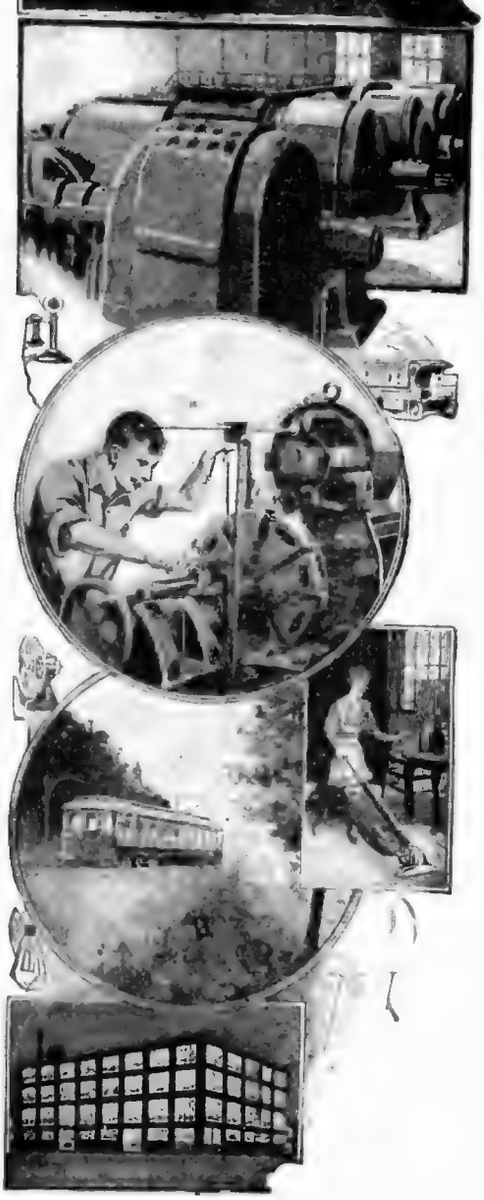

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Volume X
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Science and Invention

SEPTEMBER
1922
No. 5

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"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" HUXLEY

Time

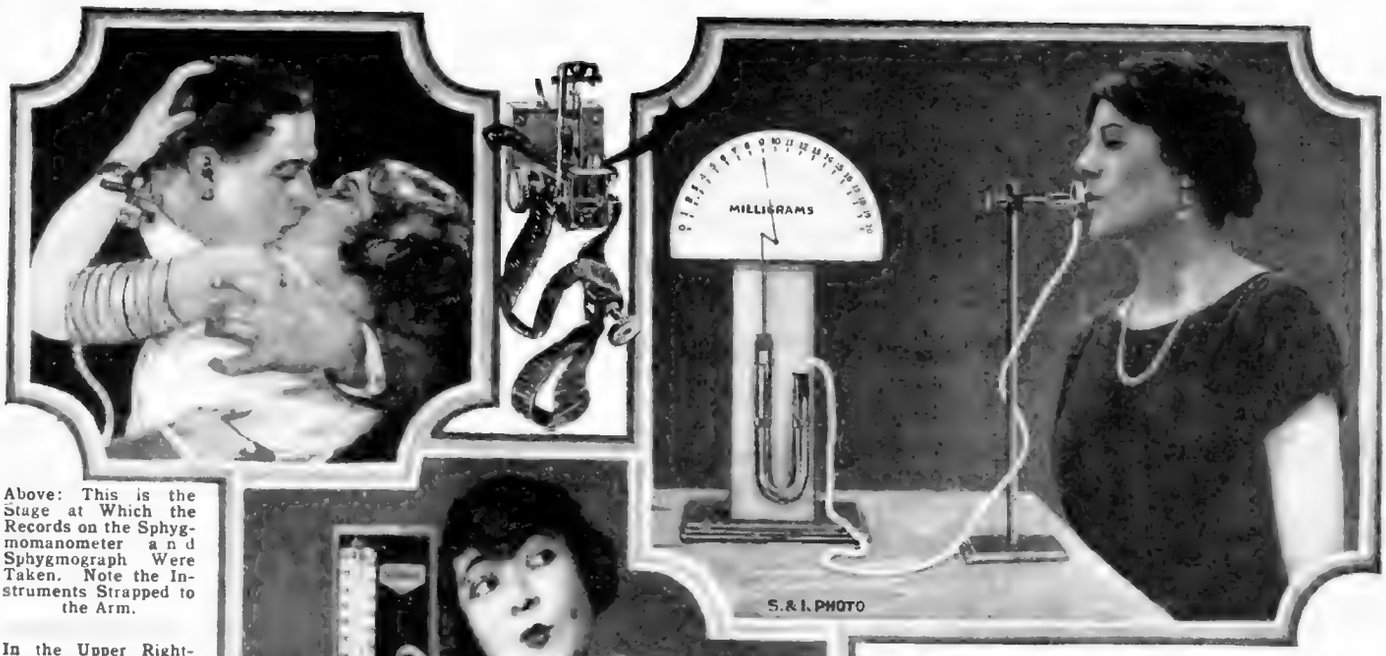
ONCE, when the earth was young, and before the human element had appeared upon this planet, the thing which we call *time* was non-existent. Time, as we know it, is an arbitrary thing, set up by us humans, which marks the interval between certain events. In the animal kingdom, time is not known as we know it, or if it is, it is recognized only by instinct. To make this clear: An animal, such as a cat or dog, may be trained, and will know, if the training is persistent enough, either by habit or otherwise, that feeding takes place at a certain time of the day. Animals will learn to know the exact period, in which, of course, the time element is involved, yet it is doubtful whether the animals in this instance are aware of the thing which we call time. In their case, it probably is an instinct prompted by hunger or the desire to eat. Many animal habits are thus formed into which a time element enters, but they are mostly instinctive. For instance, hens will go to roost as soon as the sun sets. The time element here changes from day to day and in the Winter the hens sleep for a considerably longer period than in the Summer, due to the seasonal changes. It may be doubted whether the hens are aware of the fact that in the Summer they sleep only half as long as in the Winter. In other words, we may say that their "time sense" is not developed at all, as is that of the human being.

We have intimated above that time is in the main a purely human thing. Out in space there is no such thing as time. Time, applied to the myriads of suns and planets, is meaningless, and does not even exist. Unconsciously the human mind tries to figure everything by its time standard, which often makes for mischief and non-comprehension of the universe. When we say, for instance, that the earth has existed for millions of years, such a statement immediately becomes incomprehensible to us, because we can not think in such large units. The human life is so short that once we go beyond a few thousand years, any additional time becomes too great for the mind to grasp. The scientist, who thinks in different terms from the average human being, and who is confronted by facts, knows the limitation of the human mind as far as time is concerned, and understands full well how the average man will scoff at the idea that a certain rock or meteor may be a billion years old. The ordinary human mind simply can not grasp such facts.

If we go down the scale and if we look into a microscopic world, where microbes live only for hours, or at the most, for days, we have a good analogy as to our own time element. We can imagine that a microbe who lives only for a few hours looks upon these few hours as if they were expanded into a hundred years. In other words, the time scale of a microscopic world would be on a different scale than the time scale used by us. Conversely, we can imagine super-beings that live on a higher plane than we, where the time element again changes and where the span of life for those beings might be a billion years. Just as in our microscopic world the lapse of one year on our time scale would be so large as to be unthinkable, so would the time scale of a billion years in the super-world appear preposterous to us.

The idea of time is based, on earth, upon the revolution of our planet. A certain time elapses between the rising and setting of the sun. This makes our time scale. It is, of course, purely dependent upon the revolution of the earth.. Suppose we were to take a human being and transplant him to some dead sun, which was a companion to another live sun. Assume that one of these suns had cooled off and become a world like the earth. The two suns revolve about each other without revolving on their axes. If a human being were placed upon the side illuminated by the other sun, he would have perpetual sunlight. If there were an atmosphere upon this dead sun, there would be continuous daylight. The world, to such a human being, would stand absolutely still. He would always see the sun at the same point in the sky, and there would be no sunset and no sunrise. For this being there would be no time. The idea of time would probably never enter his head. If he had never seen a clock or a watch, he would be in a timeless world. There would be no stars for him to see, because he would be living in eternal sunshine, and he would have no means of making calculations as to the speed at which the two suns were revolving about each other. Of course, this is only a supposition, and the example was cited only to show that time itself is meaningless in the universe and that if we wish to read evolution rightly we must emancipate ourselves entirely from the earth-made time element.

H. GERNSBACK.



Above: This is the Stage at Which the Records on the Sphygmomanometer and Sphygmograph Were Taken. Note the Instruments Strapped to the Arm.

In the Upper Right-Hand Corner is an Instrument for Measuring the Minimum Impulse Required to Produce a Sensation. Individuals on Either Side of the Instrument Record a Dual Impulse.

Lower View: Another Style of Manometer for Measuring the Increase in Blood Pressure During Osculation.

Analysis of the Kiss

By JOSEPH H. KRAUS

HAVE you ever stopped to consider exactly what a dissected kiss is? Have you ever considered stripping the kiss of all sentimentality, reducing it to a mere scientific rating, where it is weighed and measured, sub-dividing it to the point where it will give a rating in horse-power, and checking up its action on the heart and blood streams? Have you ever thought of the reasons why lovers kiss each other on the lips?

As a matter of fact in many foreign countries kissing upon the lips is not practised. The lips are not the most sensitive part of the human body, and in those countries where the delicate red curve is made use of, it has been definitely decided that force of habit is the predominating factor. There are countries where a kiss is entirely unknown, where the union of two lips with its simultaneous myriads of sentiments and sensations of love, desire, fear, respect and abandonment, is not in vogue. Physiologically the kiss is the first animal manifestation of love. A hand shake is full of reserve, or for that matter full of hope. The kiss is another and perhaps more exquisite manifestation of the sense of touch similar to the hand shake, and analyzing it further, we know that from the sense of touch most of our other senses are derived. Ordinarily, the kiss is disagreeable when the lips are cold.

The minimum pressure needed to excite a sensation equivalent to that upon the lips, differs considerably when impressed upon the various parts of the body. Thus a kiss impressed with the force of two milligrams on either the forehead, temple, nose or cheeks, three milligrams on the palm of the hand, five milligrams on the eyelids, and fifteen milligrams on the palm of the index finger, is equivalent to a kiss upon the lips. This latter would have to be impressed with a pressure of five milligrams, in order to incite any sensation.

In our illustration, we show an instrument used for determining the pressures exerted by the lips. This instrument consists of a small tambour about 1½ inches in diameter, and only ¼-inch thick. This is covered on both sides with a rubber diaphragm. It is filled with water, which connects by means of a flexible rubber tube to a U tube also so filled. In the further end of the U tube, is a float communicating in turn with the lever of a scale, which is graduated in milligrams. Before the record is taken, the lips of the two individuals are permitted to come barely in contact with the opposite thin walls of the tambours. The scale is then set at zero after which any record may be made, as desired. Various styles of tambours are used where different results are to be obtained.

Today, when one judges a person's degree of culture by his or her kissing, and osculation has become the mirror of society—after its ultimate analysis, it remains plain, barbarous and brutal. At fairs and other social gatherings, kisses are often sold—sometimes for ten cents and sometimes to the highest bidder.

Yet what is the value of such a kiss? Perhaps very shortly, these kisses will be weighed and measured, and prices equivalent to their actual worth will be offered for them, because such a kiss has had all sentiment removed therefrom, and becomes purely a business proposition; as such, it should be weighed and measured.

An ordinary manometer makes an exceptionally good *kiss-meter*, because during stages of real excitation, where the impulse is actually felt, not only does the heart beat quicken, but the blood pressure also increases. The blood pressure in women is much more uniform than in men and ranges from 85 to 155 millimeters, whereas amongst men it ranges from 90 to 175 millimeters of a mercury column. Fifty per cent of the readings

(*Continued on page* 502)

Actual Records Obtained on the Sphygmograph Before and After Osculation. The Blood Pressure Readings are also Given. The Upper Records on Either Side are the Normal Pulse Beats as Recorded by the Sphygmograph.

Flowers Everlasting

THE everlasting flowers are characterized by a special development of their floral envelopes, which are dry, membraneous and vari-colored. This prevents wilting when they are used as a cut flower. The greater number of them are natives of Africa, a few are found in the vicinity of the Mediterranean Sea, while some are inhabitants of Australia.

The true everlasting flowers (Helichrysum) belong to the vast group of the Composite family. Of these the Australian H. bracteatum is the best known, many of its beautiful varieties being cultivated in the garden. Forms have been developed which produce all shades and tints of light, dark and purple red, pale yellow, rose-white, flesh color and light and dark brown. To this must be added that their size varies from small to large flowers, some being simple while others are double.

These flowers require but little preparation in order to keep them indefinitely. Just before their full development, while a few of their colored petals are unfolded, they are cut off with long stems, the leaves removed and the flowers tied into a little bundle. Then they are placed in a large, roomy paper bag and the whole is hung in a shady place in such a way that the flowers are inverted.

This is all that is necessary. The flowers do not have to be colored or tinted, they keep their natural hue. These plants do not produce a fiery red flower, but the globe amaranth or immortelle (*Gomphrena globosa*) has a crimson head, and when this species is dried it still retains its dark red color. White and rose-colored flowers are also known of this form. In appearance they somewhat resemble the flowering clover.

Other plants are not so well adapted for preservation, although flowering ornamental grasses are also used. Here a large variety can be found for ornamental uses. Some produce massive bell-shaped flowers hanging from a thread-like stem; others are fluffy and dainty in appearance, while still others are soft and lace-like. These plants do not keep their original green, they become a yellow straw color. In spite of this loss of color, they are charming and attractive vase plants.

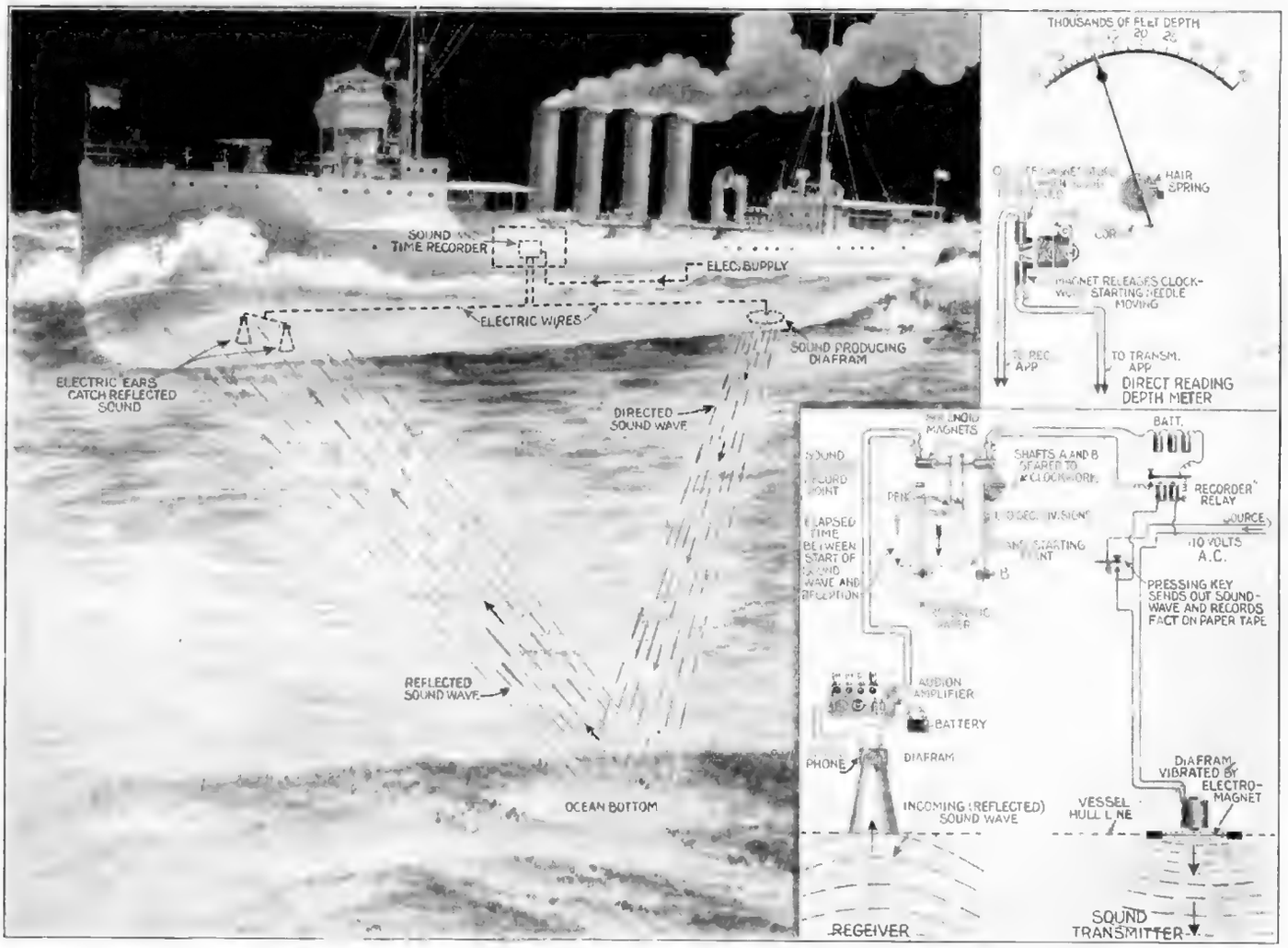
Soft-petaled flowers rarely last more than a week or so, but these delicate and fragrant blooms can also be prepared so as to last for years. The process is by no means difficult and the work is exceedingly interesting.

For the following process those flowers which do not have too much sap are ideal: Each blossom is dipped into a vessel containing a solution of gum arabic which is not too thick in its consistency. Then they are hung on a line to dry. Care must be taken that the individual plants do not touch each other. For this purpose the stem of each plant is provided with a piece of wire, which can be hooked over the line. The dipping is repeated three or four times, but each preceding coat must be dry before the following coat is applied. In this way the flowers are provided with a transparent impervious coating, which prevents the access of air and so preserves them.

The same effect is obtained by coating the plant with bees wax or paraffin. The paraffin should not be really hot, but only warm enough to keep it fluid. Fresh cut-flowers which have not developed too far are best,

(*Continued on page* 480)

There Are a Number of "Everlasting" Flowers, as Pointed Out by Dr. Bade, Which Are Practically Self-Preserving, But it is Relatively Simple to Preserve Soft Petaled Flowers, so That They Will Last For Years. The Photos Herewith Show Several Specimens of Preserved Flowers in Dr. Bade's Collection. The Two Upper Photos Show Respectivley, Helichrysum Bracteatum and Xeranthemum Annuum; the Center Photo Shows Flowering Grass in a Vase; the Two Lower Photos Show Lunaria Biennis (Seed Pods) and Hydroid Polypo.



The Apparatus Illustrated Above, Both in Detail and in Actual Use on a United States Naval Destroyer, Has Recently Been Given a Lengthy Test by Its Inventor, and the Navy Department is Very Well Satisfied With the Results Obtained. The Principle of Its Operation is Quite Simple: A Powerful Sound Wave is Directed Toward the Bottom of the Ocean, or Other Body of Water, and the Exact Time Elapsing Between the Moment When This Wave is Started From the Vibrating Diaphragm in the Rear Part of the Vessel, and the Moment When the Reflected Wave is Picked Up by the Microphonic "Ears," Located in the Forward Part of the Vessel, Makes it Possible to Ascertain Directly How Many Feet Deep the Water is at That Point. The Time Required for the Sound to Reach the Bed of the Ocean Is One-Half the Total Elapsed Time Between the Start and the Reception of the Sound Wave. Automatic Apparatus for Recording the Elapsed Time and Also Indicating Directly the Depth of Water in Feet, Are Shown at the Right of the Picture.

Sound Wave Measures Ocean Depths

By H. WINFIELD SECOR

SOUND travels through water much more rapidly than it does through air, or roughly about four and one-half times as fast. In other words, the velocity of a sound wave in water is 4,700 feet or nearly one mile per second. A recent report from the Navy Department at Washington, tells of a new deep sounding device, which utilizes this fact, coupled with that of the reflection of the sound wave from the ocean bed, which is recorded by an ingenious apparatus. Knowing the time elapsed between the sending out of the sound wave and the instant of its reception, when the reflected wave strikes the distant apparatus in another part of the vessel's hold, it becomes clear that we have by this simple philosophy provided a ready way of measuring the depth of water through which the sound wave has traveled and been reflected. If the water, for example, was 4,700 feet deep, then the time elapsing between the sending out of the sound wave and the reception of the reflected sound wave would be two seconds. The observer by dividing the elapsed time by two, will, therefore, know how many seconds it took the transmitted sound wave to reach the ocean bottom. For instance, if the elapsed time between the transmission and reception of the time was fourteen seconds, then dividing this by two, would give seven seconds as the time required for the wave to reach

New Invention Measures Ocean Depths by Sound Waves Automatically

the bottom; the other seven seconds being required for the reflected wave to reach the ship again. Multiply seven seconds by 4,700, the velocity of sound in water, we obtain 32,900 feet as the depth of the water at that particular point.

There are several different apparatus in use for both transmitting and receiving sound waves under water; one of the simplest transmitters comprising a metal diaphragm mounted in the hull of the boat, as here shown; this diaphragm is thrown into vibration by a powerful electro-magnet through whose coils an interrupted or else an alternating current is passed. The reception of the reflected wave is effected by a sensitive microphone, or microphones, placed at the end of a small chamber, as illustrated, or else placed flush with the vessel's hull, the sound wave vibrating the diaphragm, and acting on the carbon granules of the microphone, which thus changes its electrical resistance in response to the sounds.

The method of operating such an apparatus is as follows:

The operator presses the key for a short time, and a sound wave is propagated from the vibrating diaphragm of the transmitter toward the bottom of the ocean or other body of water. When the reflected wave returns, it impinges against the diaphragm of the microphone. This fact is made known by listening in to a telephone receiver connected with the microphone, or better still by connecting the microphone circuit with a graphic recording meter of one form or another.

Two methods of recording the exact time-instant when the sound was sent out, and when it was received are here shown. The first recording instrument has two pens mounted in front of a moving paper strip, this paper being moved by the pen points at a fair speed by a clock-work. Each of the cross lines on the ruled paper is equivalent to let us say, one-tenth of a second. If the transmitting pen indicates a wiggle or notch on the chart, and after the received sound wave has caused the receiving pen to make a second notch mark on the chart, distant ten divisions from the mark made by the transmitting pen, then a total time of one second has elapsed between the sending out and the reception of the reflected sound wave.

A second instrument which will indicate the depth of water in feet or fathoms direct-

(*Continued on page* 482)

How Experts Identify Discharged Bullets

WORTHY successors of Cartouche and of Mandrin, three master bandits entered a fast train on the Marseilles road to rob the travelers. One of these criminals shoots with his Browning, the courageous officer who resisted him. Once having accomplished their sinister ends, the robbers sounded the alarm bell and as the train slowed up, jumped out on the roadbed and fled. The police on the other hand lost no time in catching the fugitives in Paris, but in the fight which ensued two of the dangerous malefactors fell. One of them only, Mecislas Charrier, an intellectual in his own line, appeared before the court to give an account of his misdeeds.

The investigating Magistrate in charge of the affair, wished to have irrefutable proof, which could be placed in the brief of accusation, and directed Edouard Bayle, expert of the tribunal of the Seine, and in the service of the judiciary for identification of criminals, to examine all the arms which were seized, so as to be able to say from which weapon the ball was discharged, marks of which had been found in the woodwork of the car. In the recent case of Mme. Bassarabo in the Parisian courts, analogous problems came up, and the same happens in a great number of criminal cases. This fact inspires us to describe the new and little known methods employed by technicians to study the wounds produced by firearms.

In a general way, two typical cases present themselves:

1. A ball is found at the scene of the crime by the police, or else has been extracted from the body of the victim in the course of the autopsy, made by the court's physician. The question is to determine with certainty the pistol that discharged the bullet.

2. From the traces left by the discharge stains, metallic particles left by the ball, marks produced by the powder upon the skin, clothes, wood, a wall, etc.) the nature of the powder, the kind of ball, and possibly the model of the weapon discharged, must be ascertained.

The first determinations of caliber and form are easily made by examination of the ball: this immediately leads to the deduction, whether it has been a gun or a carbine, a revolver or an automatic pistol. When this first point is determined, it remains to be found out which one among the arms of the same category and of the caliber which has been proved in the case, was that from which the ball was discharged or the cartridge shell ejected.

Now the microscope comes on the scene for identifying the marks left on the ball or the shell by the friction with surfaces, or by the explosion. These marks are found to be identical on all balls or cartridge shells coming from the same weapon; they are due to the scores and scratches always existing on the parts of arms to which the armorer judges it useless to give a perfect polish; for example, the rifling of the barrel, the grip of the ejector, and the bolt or hammer which dented the cap of the cartridge shells.

As a starting point, let us suppose, that in the autopsy a ball was found of 7.65 millimeters caliber, .30 inch, cylindrical in shape and jacketed with nickel. It came from a revolver or automatic pistol. Suppose they have captured among the suspected individuals three automatics. Which is the one which did the killing? To ascertain this, the expert begins by shooting several balls from each pistol, using as his target, bags stuffed with rags and cotton waste, so that the projectiles will receive no mark and no deformation. Then putting on each ball a mark corresponding to the pistol from which it was discharged, he mixes them all together. After these preliminary operations, the identification is carried on by the judiciary with a view of distinguishing these projectiles among themselves without paying attention to their distinctive marks.

The bullets are placed in a little support as shown, which by means of a spring holds them with sufficient firmness and permits them to turn about as desired, when placed on the stage of the microscope. On turning them on the stage, the observer presents successfully to the objective all the marks made upon the projectile by the helicoidal rifling grooves and lands of the barrel. On the surface of these marks little scratches will be seen due to defects in polishing, and to which we will allude later.

These little marks often present a physiognomy so very distintive as to identify immediately all balls from the same source, but to make the distinction, a special lighting apparatus has to be used. A converging beam may be projected on the object at a very small angle which brings into relief the high points of the scratches because of the shadows produced. Sometimes an

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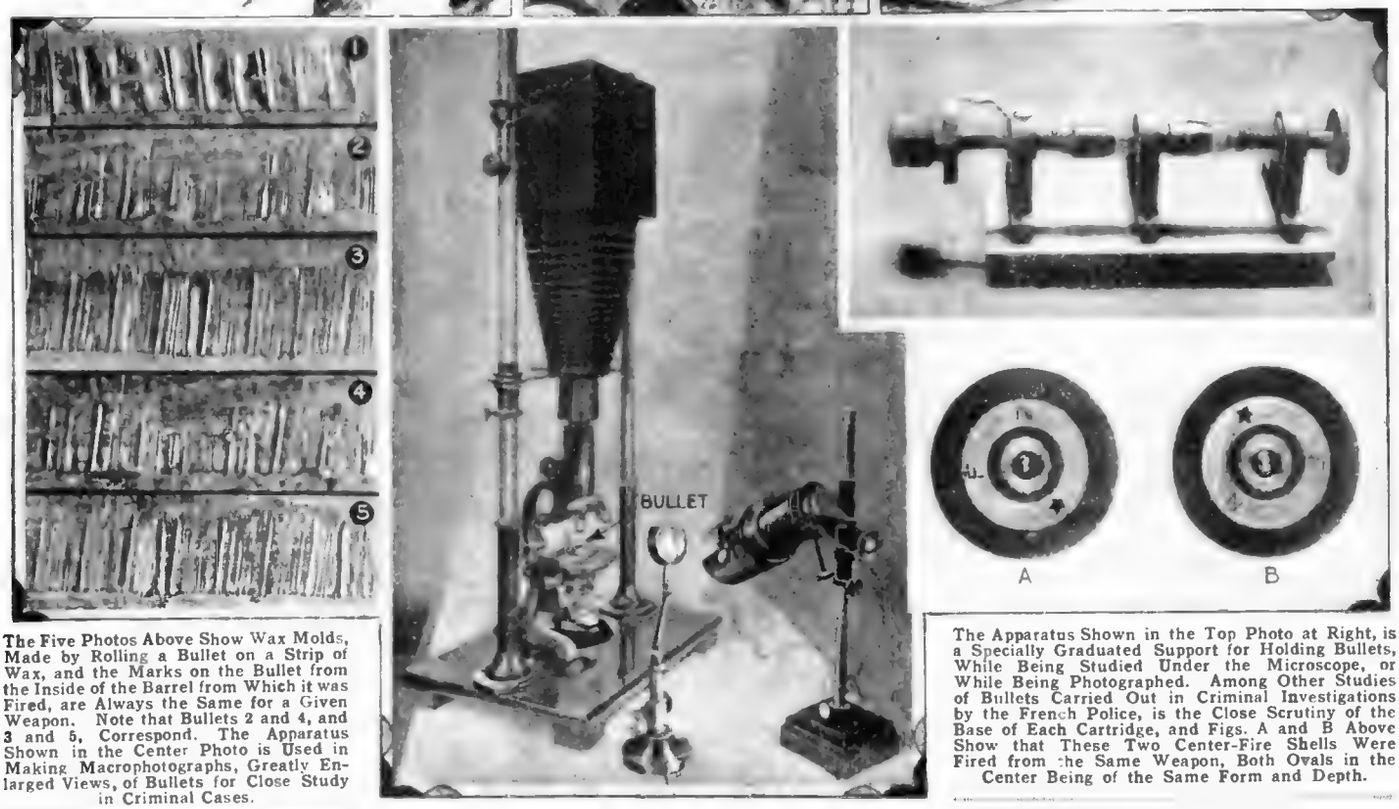


The Five Photos Above Show Wax Molds, Made by Rolling a Bullet on a Strip of Wax, and the Marks on the Bullet from the Inside of the Barrel from Which it was Fired, are Always the Same for a Given Weapon. Note that Bullets 2 and 4, and 3 and 5, Correspond. The Apparatus Shown in the Center Photo is Used in Making Macrophotographs, Greatly Enlarged Views, of Bullets for Close Study in Criminal Cases.

The Apparatus Shown in the Top Photo at Right, is a Specially Graduated Support for Holding Bullets, While Being Studied Under the Microscope, or While Being Photographed. Among Other Studies of Bullets Carried Out in Criminal Investigations by the French Police, is the Close Scrutiny of the Base of Each Cartridge, and Figs. A and B Above Show that These Two Center-Fire Shells Were Fired from the Same Weapon, Both Ovals in the Center Being of the Same Form and Depth.

Giant 30-Passenger Triplane

By A. L. WILKINSON

THE middle west is giving commercial aviation a much-needed impetus by sponsoring the construction of a giant 30-passenger, tandem triplane, to be built in the shops of the Aerial Navigation Company at Kansas City, Missouri.

This tremendous aircraft, 60 feet in breadth at the front wings and with a span of the rear wings of 40 feet, is the first of the company's line of aircraft to carry passengers and freight between the three great middle western centers, Kansas City, St. Louis and Chicago.

It involves many unique features, chief among which is the design providing for a variable angle of incidence, whereby the wings are movable at the pilot's will to increase stability, and take advantage of every varying air current. The wings are controlled by a double chain drive operating through worm gears, which assure a stationary position for the wings unless the pilot wills otherwise. Each drive works independently of the other and either will control the movements of the wings.

Following are some of the specifications of the plane which will serve to give an idea of the immensity of the project.

Span of front wing, 60 feet. Span of rear wing, 40 feet. Length of fuselage, 36 feet. Overall length of machine, 45 feet. Height of fuselage, 6 feet, 4 inches. Width of fuselage, 8 feet, 3 inches.

The approximate estimated weight of the plane, loaded, is 13,000 pounds. It will carry 30 passengers, including the crew, and 1,000 pounds of baggage. The power plant consists of two powerful Liberty motors, housed outside the fuselage, but easily accessible to it.

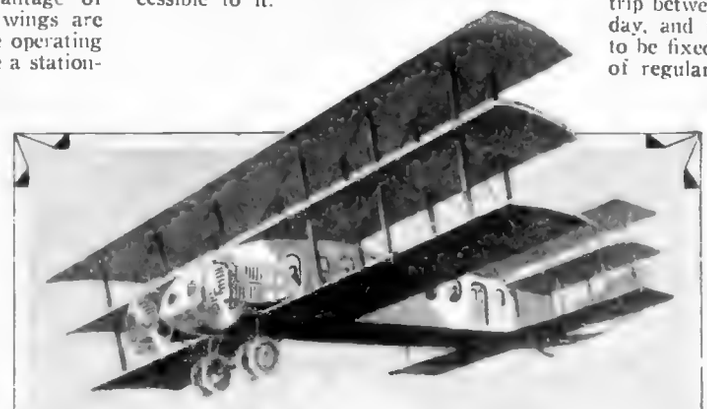
The tandem plane is designed to give the maximum amount of longitudinal stability.

Flying speed is 120 miles per hour; cruising speed, 90 miles per hour; landing speed, 23 miles per hour; take off, 30 miles per hour.

The fuselage is shaped like a true wing section, and will therefore help materially in the lifting when leaving the ground and carrying when in the air.

The plane was constructed under the supervision of competent aeronautical engineers, who are confident that it will solve many of the intricate problems of commercial aviation, by the simple expedient of increasing many times the efficiency of the airplane as a passenger conveyance.

It is planned to make at least one round trip between the three points mentioned each day, and the cost to the passengers is said to be fixed at a point only slightly in excess of regular railroad rates.



A New Giant Airplane Having a Capacity of Thirty Passengers and One Thousand Pounds of Baggage, is Shown in Flight in Picture at Right. This Tremendous Aircraft Measures Sixty Feet in Breadth at the Front Wings, While the Rear Wings Have a Spread of Forty Feet. This is the First of a New Line of Airplanes Designed to Carry Passengers and Freight Between Kansas City, St. Louis and Chicago.

The Fuselage or Main Body of the New Giant Triplane Is Seen in the Picture Below; Compare It With the Men Standing Behind the Frame-Work. The Fuselage Measures 36 Feet in Length, and Is 6 Feet, 4 Inches High, and 8 Feet Wide. The Flying Speed of This Craft is 120 Miles per Hour; Cruising Speed 90 Miles per Hour; Landing Speed, 23 Miles per Hour; Take-Off Speed 30 Miles per Hour. It is Believed That Passengers Can Be Carried at a Cost Only Slightly in Excess of Regular Railroad Rates.

Some Idea of the Size of the Giant Wings, or Rather the Frames for the Wings, is Gained by Looking at the Picture Below, and Comparing It With the Size of the Men in the Picture.

Gas Pistols Halt Robbers

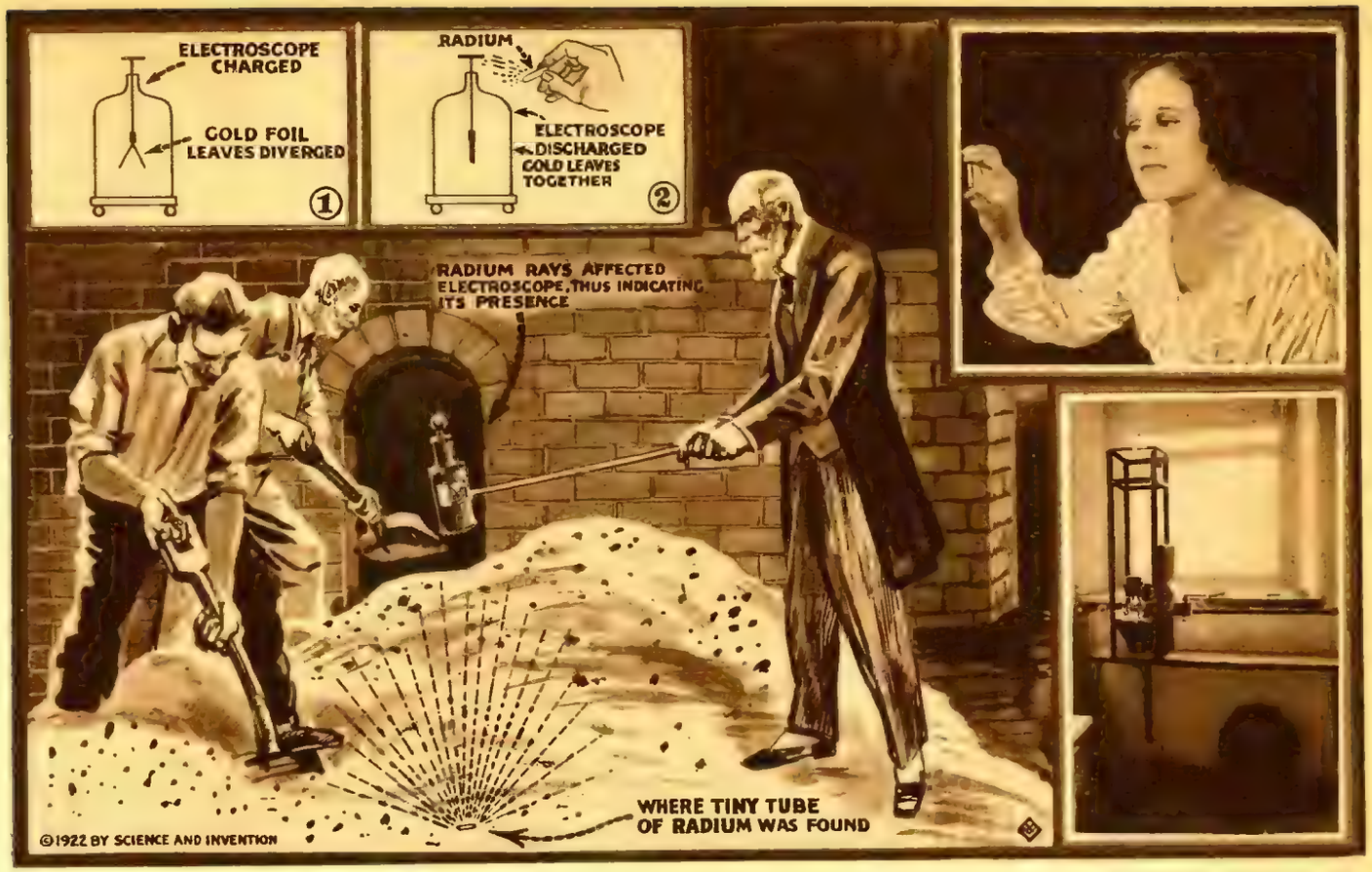
One of the latest German novelties for the protection of unescorted women and girls, or those alone in offices, is the gas pistol—it shoots a stream of gas which serves to stupefy and render unconscious the would-be robber or thug. The effect of this insensibility lasts for some time, but the effect is not fatal. The size of the pistol shown in the accompanying photo makes it rather impractical to carry in a skirt pocket, especially in these days when little Miss Chicago or Miss Broadway comes tripping down the street with about two square feet of material around her limbs, but no doubt the genius inventor of this new gas pistol for civilian use, will perfect a smaller model which can be carried in the pocket. We have had ammonia pistols for years, and they are not half bad, if they are properly loaded and manipulated to serve as protection against savage dogs, robbers or molesters.

The operation of the gas pistol is as follows. The stupefying gas is concentrated in small glass cartidges, and when the pistol is to be used, it is fired by pulling the trigger, which breaks the cartridge, and the gas by expansion, rushes out of the barrel like a stream of invisible water.

The Newest Idea in Pistols is That Here Illustrated in Use by a Young Lady, and Which Fires a Stream of Gas at the Would-Be Thief, Rendering Him Unconscious for Some Time.

The deadliness of the gas fillers can, of course, be regulated, and if some of the gas, as was used in the war, should be employed in these pistols, the effectiveness of the gun would be equivalent to the bullets fired from an army revolver. It is, of course, imperative that the gun be employed at close range, and it is possible that the highwayman, if close enough, could turn the nozzle of the gun around at the person wielding the same, rendering that person unconscious immediately, and make his robbery much more effective, more thorough and safe. It is therefore quite important that a much smaller pistol be designed for private use.

It is a good thing that Lewisite gas, discovered at the close of the war, is not available. This gas, if placed in small cartridges, and fired from a gun of this type, would probably deal death to several hundred individuals, as well as destroy all vegetation. A few drops on the skin spells death.



A Minute Tube of Radium Valued at $1,000.00 was Recently Lost in a Brooklyn, N. Y., Hospital, and the Interesting Story of How it was Finally Located Under a Ton of Ashes is Here Told in Detail. The Instrument Used to Locate the Radium was an Electroscope, a Device Provided with Two Very Delicate Gold Foil Leaves, Which Tend to Fly Apart When the Brass Rod, on Which They are Supported, is Given an Electric Charge from a Stick of Sealing Wax Previously Rubbed on Cat Fur. When a Radio-Active Substance is Approached to the Ball of the Charged Electroscope, it Discharges, the Leaves Coming Together, Owing to the Air in the Vicinity of the Ball Becoming Ionized by the Radium Rays. One of the Photos on the Right Shows a Young Woman Holding a Tube of Radio-Active Material About the Size of That Located Under the Ash Pile, While the Lower Right-Hand Photo Shows the Laboratory Type of Electroscope Used in a New York Hospital for Measuring the Strength of Various Radium Applicators Used in the Treatment of Cancer and Allied Diseases.

Find Lost Radium in Ash Pile

AFTER vainly hunting in the ordinary way for a lost tube of radium, valued at $1,000.00, which disappeared recently at the Methodist Episcopal Hospital at Seventh Avenue and Seventh Street, Brooklyn, experts with a radium detecting apparatus were called in and finally, with the aid of this detector, they uncovered the tube from a pile of ashes that had passed through an incinerating plant in the hospital yard. The radium was uninjured by its fiery passage through the furnace.

The searchers who preceded the experts said their hunt was like "looking for a needle in a haystack," because the lost tube was so minute. It contained ten milligrams of radium. When the first search for it began, several of the lay employes at the hospital offered their services, but they quickly drifted to other duties when a physician, describing what they were to look for said:

"The tube and its contents are about two-thirds the size of the large end of a darning needle."

Then Dr. J. E. Holmes, Superintendent of the hospital, appealed for aid to the United States Radium Corporation, at East Orange, N. J., where the radium had been purchased. The corporation sent Dr. E. D. Leman, its chief chemist, and its technical assistant, Marchall Mayes, with an electroscope, which is affected by the presence of radio-active rays.

This scientific hunt started in a ward where the lost radium had been used in an operation. Through the different rooms and wards and on down to the engine and boiler rooms the search proceeded with no results. As Dr. Leman and Mayes approached the incinerating plant in the yard, the indicator showed its first activity, which increased in intensity when close to the pile of ashes. Under direction of the experts, diggers carefully lifted off layer after layer of the pile, and after removing nearly a ton of it, the tiny tube was found.

Dr. Holmes believes that the tube of radium was lost through the carelessness of some one removing bandages and other discarded things from the operating room, in the folds of which the tube was not observed. In that way it reached the refuse taken to the burning plant. The lost radium formed part of the $15,000 worth in use at the hospital.

Two of the accompanying diagrams show the action of any radio-active material on a charged gold leaf electroscope. The first diagram shows the electroscope charged by approaching the brass ball atop the instrument with a piece of sealing wax or glass rod rubbed with wool or silk respectively, causing the gold leaves to diverge or spread apart owing to the like charges. The second diagram shows how the charge held on the gold leaves is dissipated or permitted to leak off through the ionized air about the metal ball atop the instrument, when a tube containing any radio-active material is brought near. Those possessing an electroscope who desire to carry out this experiment, can try the experiment of causing the electroscope to become discharged by approaching a spinthariscope toward the ball of the electroscope after it has been charged, taking off the metal cap on the end of the spinthariscope.

One of the accompanying photographs shows a young woman holding a small radium luminous material tube, tubes of this size containing radium salt of known strength being frequently used in the treatment of cancer and other diseases, while the second photo shows the laboratory electroscope used in a large New York hospital for measuring the strength of various radium applicators. The strength of the radium is determined by first measuring the distance from the electroscope and the time required to discharge it with a standard tube of radium; and then carefully measuring the distance of the electroscope, and the time required for the radium tube of unknown strength to discharge it.

Radium is being recognized more and more as an efficacious method of treating cancer and other similar diseases, especially when used in combination with X-ray therapy. One of the particular methods of applying the rays of radium in cancer treatments used in a leading New York hospital, is to convert the radium into radium emanation, which is in the form of a gas, and a small quantity of the pure radium evolves a very large amount of the gas. Sealed glass tubes containing the radium emanation, which is effective for about a week, are usually placed in contact with the diseased tissue; while one method of applying it consists in placing the radium emanation in minute glass *bullets*, about the size of a small pin and ¼ inch long, which are shot into the diseased tissue with a special *pistol* —these tubes being left in the tissue permanently.

"It was a Human Leg, and the Delicacy of the Tissues Showed Without Doubt That it Belonged to One of the Fair Sex, and a Very Young Person at That! This was Further Confirmed by the Beautiful Silk Hose and the Delicate Venetian Point Lace That Encircled the Limb. Gradually, Before the Astonished Eyes of the Spectators, the Trunk and Arms Appeared, and Finally the Head, the Face Being That of a Beautiful Young Girl of Twenty. . . ."

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

—No. 8—
The Secret of Electrical Transmission

"WELL, doctor, what new invention are you working on now?" asked Silas Rockett, as he entered the laboratory one fine spring morning.

Doctor Hackensaw removed his spectacles and carefully wiped them, as he answered: "I am working upon one of the most important of the electrical problems that still remain to be solved—the *electrical transmission of bodies.*"

"You mean the sending of objects from one place to another by electricity."

"Precisely. Ever since, as a boy, I read Faraday's account of his electrical researches, I became convinced that the conveyance of bodies from place to place by means of the electrical current was not only a possibility but had even been accomplished already!"

"What?"

"Certainly. When we silver-plate an object, we put the object to be plated at one end of a tub and a bar of silver at the other end. The electrical current carries the particles of silver from one end of the tub to the other—in other words, we have an actual transmission of matter from place to place by electricity. It was Faraday who suggested the name of *'ions'* for the particles that are thus carried."

"Yes, but in silver-plating the silver particles have only a few feet to travel. Electrical transmission would be useless unless you could send bodies a considerable distance."

"True, but the question is only one of degree. Hertz sent wireless waves a few feet and Marconi who came afterward had little trouble in sending them thousands of miles. My problem was similar to Marconi's. The first step was already made, I had merely to increase the distance the ions should travel. I realized at once the importance of the subject, for transportation charges form an important item in the price of almost every article of merchandise, and anything that would cheapen transportation would help reduce prices."

"But is not electrical transmission expensive?"

"Not if we use the waves of the ocean for generating our electrical power. We have there a practically inexhaustible source of energy. Besides, some goods are wanted in a hurry, and think of the time that would be saved in sending an object from New York to San Francisco by telegraph instead of by train!

"My first attempts, however, were not directed toward sending solid bodies by wire. I chose a simpler problem—namely that of sending electrical impulses. You know how the stock-ticker works. One man sends a

(*Continued on page* 491)

Author's Note. The problem of sending bodies from one place to another by electricity is one that is certain to be solved at no distant date. We can, at present, send bodies a few feet in this manner, for, in the process of silver-plating, the ions or particles of silver travel several feet through the electrolytic liquid. The "atomic or ionic" slowness of their progress is too great for a long journey. But some future genius will undoubtedly find electrolytes offering less resistance to the quick passage of the particles.

To send the particles by wireless is a much more difficult problem. *Undirected* wireless would, of course, be out of the question, as the particles would be scattered in all directions. But why might not the ions be transmitted by *directed* wireless. If we admit the corpuscular theory of light—and, in my opinion, this is the only *real* theory offered, there seems no possibility in our being able some day to send a solid body from one spot to another by wireless.)

Restoring the Moon

By BURNIE L. BEVILL

MY chum, Paul Smith, and I are members of that esteemed fraternity known to the public as *reporters.* At the time the event which I am about to describe occurred, we were officially connected with the New York *"Gazette,"* which was, in the year 1933, the leading newspaper of the country, and our business was to "get the news," whatever it happened to be. We were established in the Owl Apartments at this time, and—strange to relate with regard to reporters—were taking a rest.

I remember well the Sunday afternoon that Paul and I were in our rooms discussing scientific matters of the very deepest nature, and I am quite sure now that neither of us possessed a very clear understanding of our subject. However, we were discussing inter-atomic force, discussing it in a somewhat disinterested manner, little knowing that the subject was going to claim our closest attention within a very short time.

"I say, Jim," burst out Paul after a brief lull in the conversation, "what do you think of this new idea that there is such a thing as inter-atomic force? Sounds like rot to me."

"Well, of all things!" I exclaimed. "The idea of one of your education talking in such a ridiculous manner! These days anyone knows that inter-atomic force exists, just as they know that radio waves exist; and you know that it's only a matter of some ten years since people began to understand radio."

"Well, then, suppose we talk about this new idea of Professor Comarie, that gravitation can be suspended by means of electricity passing over a metallic screen. What do you think of that?"

"What do I think of it? Why, I agree with the professor in all respects," I replied. "And just think what a wonderful thing that will be to the working people, mechanics, and so forth! I was just thinking how by this means automobiles and the like could be repaired. It would be necessary only to roll them over the metallic screen and suspend gravitation beneath them. Thus they could be raised to any height so as to facilitate repairing them underneath—no effort being required to raise them or to hold them at the required elevation."

"Yes," agreed Paul, "but suppose that when you raised the automobile, as you say, that you forgot to stop it at the desired place—why it would keep going up into the air—there would be nothing to stop it. You know this is the first law of motion. And, furthermore, physiology teaches that it is gravitation that tends to maintain our equilibrium. If we did not have this force how would we succeed in this matter while we were in the gravitationless area working on the car?"

I had to give in to Paul as I usually did upon such occasions, as he was always looking upon the dark side of matters of the kind, and managed always to bring in some objection to any suggestion that might be mentioned.

About this time Paul happened to pick up the morning paper, which had been overlooked until now, and glanced at the headlines.

"Disturbance in the atmosphere. Pressure much lowered." it read. Leaning over his shoulder, I, too, read the article, which ran:

"Washington, D. C., March 22.—For some unknown reason the atmosphere was greatly lowered in pressure during the night. From its normal pressure of fifteen pounds it has reached the alarming level of twelve pounds, and as this is quite unnatural it has caused the attention of several scientists of the meteorological department to be directed upon the matter. These men have come to the conclusion that there is some scientific maniac at the bottom of the trouble. Detectives have been warned to be on the lookout for peculiar acting experimenters over the country; and it is hoped that the fugitive will soon be brought to justice lest he be the cause of serious damage."

"Well, doesn't that beat you!" Paul exclaimed. "The idea of some scientific maniac being at the bottom of such a business! How could it be possible?"

"Very reasonable. I quite agree with the meteorological experts in the matter," I

(*Continued on page* 485)

"A Moment Later the Heavens were Opened, and with a Hissing Sound a Tremendous Object Fell from the Sky and Crashed into Stallas's Stone Structure, Shattering the Building by the Impact. We Now Observed That This Gigantic Object Greatly Resembled an Iceberg, and Upon Investigation We Learned That This Huge Mass was Nothing but Frozen Atmosphere That Had Been Solidified by the Extreme Cold of Outer Space. Apparently, the Positive Charge Had Made the Disc Doubly Powerful, so That It Must Have Drawn the Huge, Frozen Mass Upon Itself and Thereby Destroyed Itself Completely. . . ."

The End of the World--How Soon?

By IVAN L. SMITH

Will the End of the World be Due to a Dark Star Colliding with the Sun, and Thus Destroying the Earth with a Hail of Fiery Meteors?

HOW many times have you heard somebody exclaim, in commenting on some unusual disturbance, "My goodness, I thought the world was coming to an end." Well, the world IS coming to an end. Just when this highly important event will transpire and just which of several possible forces will operate in bringing it about, we are not prepared to state, but no thinking individual doubts for a moment that some day this planet will no longer be the dwelling place of life and may even cease to exist as a planet. Everything abstract or concrete of which we have any knowledge seems to develop in cycles. Plants grow, wither and die; animals are born, reach maturity, decline into old age and die; states rise from small beginnings, reach their zenith, decline and fall; whole species evolve from simple beginnings into highly complex organisms, then gradually degenerate and are exterminated in the universal struggle for existence. It is generally believed that our entire solar system, including our own little planet, is pursuing the same course of development we can observe going on all around us. We speak of "the everlasting hills," and the geologists tell us that the "everlasting hills" are standing on the site of ancient seas.

Nearly every group in society believes that the earth had a beginning. The theologist's theory of the Creation may be found in Genesis. The scientific theory differs from the biblical version somewhat, since it hypothecates the gradual evolution of the sun, the earth, the other planets and their satellites from a common nebulous mass of widely diffused gaseous matter. The "nebular theory" was first advanced by the French mathematician Laplace, and stood up under adverse criticism for nearly a century. Professor Chamberlain of Chicago University has recently

Another Theory of How All Life May Cease on Our Earth is Based on the Supposition That the Action of the Oceans and Rivers Will be Such as to Disintegrate the Land, Slowly of Course, and Eventually Wash it Into the Seas; So That in the Course of Time the Atlantic Ocean Coast-line Will be Changed As Here Shown.

evolved the "planetismal hypothesis" which meets many of the objections raised against the nebular hypothesis. Both hypotheses, however, take the gaseous nebula as their starting point, differing only in the method by which the sun and planets were subsequently formed from this common beginning. There is not room in an article of this length for further discussion of these highly interesting theories.

The point to the whole discussion is that the earth had a definite beginning. It is just as certain that the earth has had a gradual development or growth. Here again the temptation to digress is felt. Geologists have pieced together such an engrossing history of the past life of our earthly abode that the only way to avoid wandering far afield is to avoid the subject altogether, and to simply state that the earth reached its present state through gradual evolution from a gaseous mass.

Since the earth had a definite beginning and a gradual development, we must assume that it is going to have a definite end if the analogy is to be complete. It is not a question so much of whether or not our earth will some time cease to exist, as it is a question of the causes which will operate to bring this about. We may observe several forces at work which, if allowed to continue at their present rate, will some day render our globe unfit for habitation.

The Opposite Theory to the One Involving the Cessation of Life on Our Earth, Caused by All of the Elevated Land Being Washed into the Ocean, is That in Which the Gradual Absorption of All the Water on the Surface of the Earth Takes Place; When for a Time People Will Live on the Ocean Beds as Well as on the Land Now Occupied. Finally Total Extinction Occurs, by This Theory, Due to the Lack of Water.

Life cannot exist without water. The amount of water needed to support some forms of life is relatively small, but no forms known to us exist without some water. If, therefore, moisture should completely disappear from the face of our planet, said planet would cease to be of any great value as a dwelling place for human beings. Water is gradually disappearing. This highly important article is composed of a compound of two volumes of hydrogen to one volume of oxygen. Our planet started on its career provided with a definite amount of these two elements in various combinations. Only an insignificant amount has since been added through the influx of meteorites, none of which has been in the form of water, so that the permanence of our water supply depends on the earth's ability to hold on to the store of oxygen and hydrogen with which it was originally provided. This ability in turn depends on the relation existing between the earth's gravitational pull and the velocity attained by any object on the earth's surface.

It has been figured that any body having the size and mass of the earth exerts a gravitational pull sufficient to hold any object traveling at a speed of less than 6.9 miles per second. This figure represents the *critical velocity* of the earth, and measures the limit of the earth's ability to hold the elements composing it. The critical velocity of Mars is 3.1 miles per second, and of the moon only 1.5 miles per second. Any particle of matter attaining a speed in excess of the critical velocity of the parent body is free to leave it and wander at will until it bumps into some other body having an attractive force sufficient to hold it.

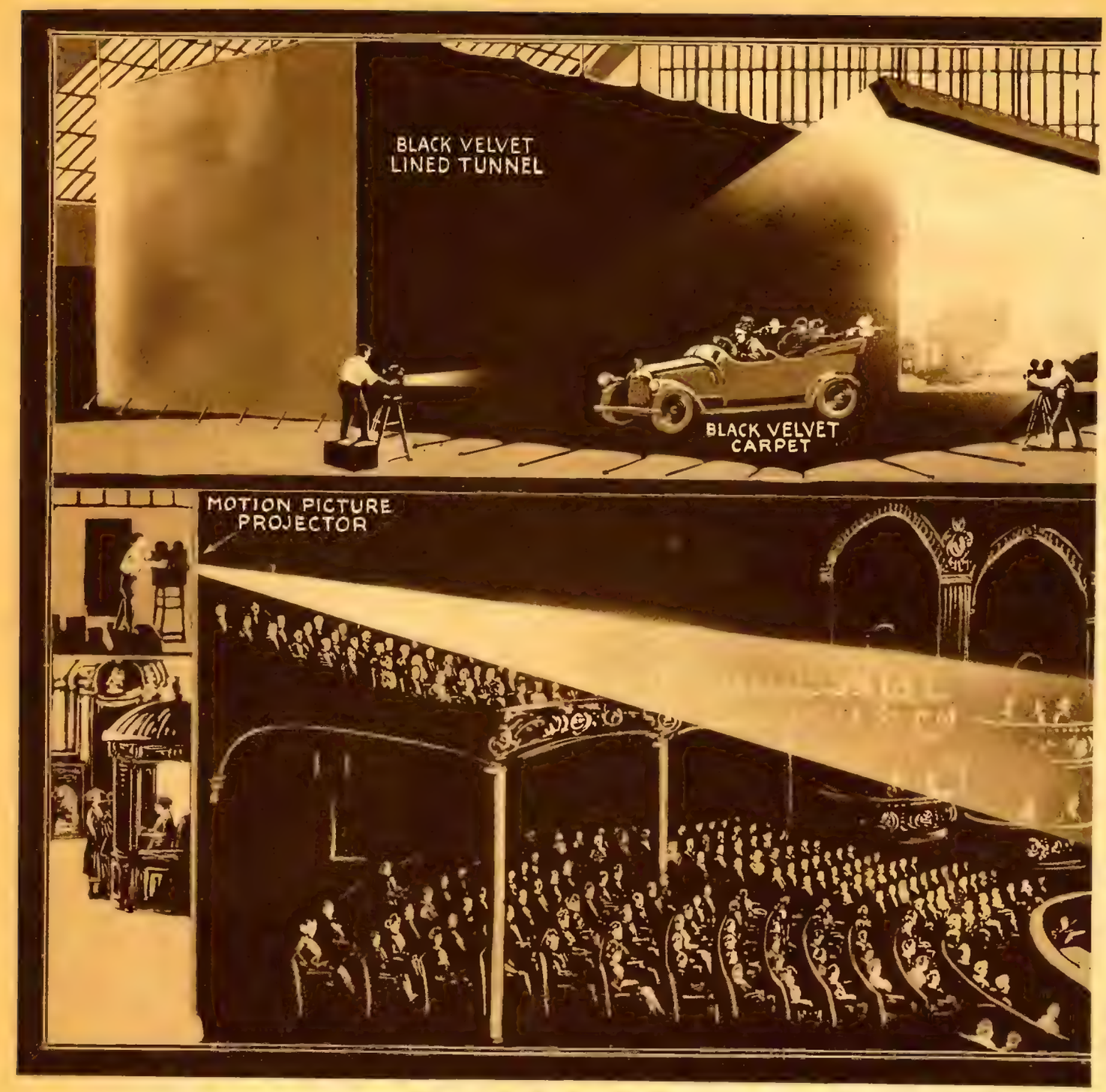
According to the kinetic theory of gases, every molecule of gas is assumed to be in incessant motion at different velocities, and these velocities may be enormously increased by collisions of molecules with one another. Clerk-Maxwell has devoted considerable time to a study of the maximum speeds attainable by the molecules of our commoner gases, and finds that hydrogen attains a speed of 7.4 miles per second, water vapor 2.5, nitrogen 2.0, oxygen 1.8 and carbon dioxide 1.6. Now these figures may be tiresome but they are highly significant. It will be noticed that the maximum velocity of hydrogen is 7.4 miles per second or .5 mile per second greater than the critical velocity of the earth, which means simply that every molecule of hydrogen is going to get up speed enough sooner or later to leave this earth of ours and go traveling through space on its own hook. That this actually happens is proven by the fact that no free hydrogen exists on the earth. Our total supply of this element is locked up in combinations with other elements which hold it fast. As further proof, it might be noted that the critical velocity of Mars is dangerously close to the maximum velocity of water vapor and the Martian water supply is admittedly scanty. It should also be noted that the critical velocity of the moon is lower than the maximum velocity of any of our atmospheric gases and scientists are agreed that the moon has no atmosphere.

From the above it will be seen that whenever water is separated into its constituent parts of oxygen and hydrogen, the hydrogen soon disappears, leaving only the oxygen free or in compound. There are several ways in which the combination forming water may be broken up. The most common way is to pass an electric current through it, thus liberating hydrogen and oxygen. This reaction takes place whenever we have a rainstorm accompanied by lightning. Various chemical reactions also result in the freeing of hydrogen. Thus sodium, potassium, calcium and various other elements, when brought in contact with water, unite with the oxygen and free the hydrogen. This also happens, for example, when steam is passed over heated zinc, iron, or carbon. It is true that there are chemical reactions constantly in progress which result in slight additions to the total water supply, but there can be little doubt that if a balance were struck, it would be found that a net loss results which, while inconsiderable from year to year, is bound to reach serious proportions as the earth grows older. We are not justified in considering the present extent of the continents compared to their extent in previous geologic periods as proof of a diminishing water supply, because there are too many possible factors which could involve a change in the relative proportions of sea and land, but it is nevertheless a fact that at present the seas cover a smaller area than they have at almost any period in the past. It is also true that transcontinental railroad lines are now running along the routes once followed by wild, rushing rivers.

Paradoxical as it may seem, there is also a possibility that the human race may some day be embarrassed by too much water. The high spots of the earth are being continually worn down by erosional agencies, and the materials composing them deposited in the sea bottoms. It is believed that there is a compensating movement deep in the earth which tends to move earth matter from under the sea floor back to a point beneath the land masses, thereby effecting a re-elevation of the worn-down land masses, and making possible a resumption of the erosional work of water, ice and wind. If the re-elevation were always proportionate to the wearing down which followed it, there would be no cause for alarm, since the average height of the land masses over a period of thousands of years would remain constant. There is reason to believe, however, that this is not the case, but that with each cycle, the material underlying the land masses becomes a little denser and the re-elevation is accordingly a little less marked. If this process were allowed to continue indefinitely, we might well expect to reach the point where the re-elevations were insufficient to keep the continents above water, and we should have an unbroken ocean covering the whole globe. This condition would not necessarily doom the planet as a dwelling place for life, but it is certain that any remnant of the human race would have to undergo considerable modification, if it were to survive such a total submergence.

The most widely accepted theory of the probable end of our planet takes the gradual loss of the sun's heat as the cause. For many years it was believed that the sun's heat was the direct result of combustion. When scientific instruments had been sufficiently de-

(*Continued on page* 489)



The Scheme Illustrated Above for Making Perspective Motion Pictures is That Recently Evolved by a French Inventor, Mr. Caesar Parolini. The Secret of Taking These Perspective Pictures With a Standard Movie Camera Lies in the Particular Method of Lighting the Actors and the Furniture or Other Properties Used in the Scene. The Floor and Background are Made of Black Velvet, and All that is Photographed on the Film are the Images of the Actors and the Furniture. The Much Desired Effect of Relief and Perspective is Intensified by the Use of Ultra Powerful Electric Lights.

Perspective Motion Pictures

THE accompanying illustration shows one of the latest advances in the motion picture art, made by a French inventor, Mr. Caesar Parolini, whereby a perspective or relief effect is obtained in a simple manner. When these motion pictures are thrown on the specially devised stage, fitted with a transparent screen, and a movable scene for the background, the actors appear to stand out in relief, the same as in the old parlor stereoscope we used to use in our Grandma's day. The top illustration shows the arrangement of the studio stage in taking the perspective motion pictures, the actors and furniture being illuminated by powerful electric lights, while all of the acting takes place in front of a so-called tunnel or chamber, which is lined with black velvet. The floor is also covered with black velvet, thus giving the effect of bold relief, and when the film is developed, and a positive printed in the usual manner, the mysterious effect is obtained of seeing simply the furniture and actors themselves, but no background whatever.

We now come to the theatre where the perspective motion picture so made is to be projected on the screen. A special stage arrangement is used, which is however, quite simple, comprising a movable background scene or series of scenes, which can be moved into position while captions are being flashed, or at other opportune moments; while the false floor covered with black velvet causes the images of the actors, furniture, etc., to stand out as in full relief, as if they were really being supported by this floor. The illusion of actual perspective is said to be perfect and also there is a marked reduction in the fatigue on the eyes.

As will be seen by looking at the illustration, the motion picture is projected on to a semi-transparent screen, placed at the stage opening or proscenium, so that the strongly illuminated background scene is readily observed through the semi-transparent front screen, the whole effect blending together harmoniously.

By painting a long continuous panorama scene on canvas placed on vertical rollers,

As Shown in the Illustration Above, the New French Perspective or Relief Movies are Projected on a Transparent Screen Placed in the Front of the Theatre Stage. The Background Scenery is Painted on a Canvas Strip, so as to be Rolled up, and the Successive Scenes are then Readily Moved into Position, by Turning the Rollers Either Manually, or by an Electric Motor Controlled from the Projecting Booth. The Insert Photo Shows How the Images of the Actors and the Furniture Appear in the Film, no Background or Floor Being Visible.

back of the transparent screen in the position shown, such scenes as an automobile racing along a road can be projected successfully, or such other scenes as a railroad train speeding along through changing scenery, et cetera.

By using some form of synchronous electric motor connected to the rollers on which the canvas scenes or panorama is supported, and connecting this with a proper control switch mechanism mounted on the projecting machine, it is possible to change the scenes automatically as the presentation of the photoplay takes place. This automatic feature could be further developed by having special index perforations on the edge of the film at intervals, where the scenes are to be changed, so that at the close of one scene, and just as a caption is to be presented, the synchronous motor on the stage will start in motion and revolve the rollers sufficiently to bring a new scene into position during the dark period, while only the caption is shown on the transparent screen. This scene change would be timed to take place in the period occupied in flashing the caption, and as the next scene started, the proper background would be in position.

The appearance of the actors' images on the positive film is seen in the photograph reproduced herewith, taken from an American film play "Hidden Dangers," featuring Miss Jean Paige. No floor or background is perceived in the film or projected picture, as becomes evident, this being taken care of by the special background scene, either moving or stationary, as already described.

There have been a number of American inventors who have spent considerable sums of money, in endeavoring to work out a simple and satisfactory method of producing a perspective or relief effect motion picture, and several of them have achieved considerable success, the editors having been present at one of the exhibits sometime ago, which seemed to possess great promise. One of the interesting features of the present French invention, lies in the fact that the background scenery may be finished in colors, and if a colored film or tinted film containing the actors' images is employed, a very magnificent effect can be obtained.

This perspective or relief effect in motion picture reproduction is very desirable from many different points of view, not only reducing the strain on the eyes, but also giving the audience a much truer and more enjoyable presentation; and finally, when they are coupled to a phonograph or other speech reproduction mechanism, it will be found that these relief movies will give a much better effect than where the ordinary flat screen movies are used with the talking attachment.

Fig. 1 (Upper Left) Shows How the Time on the Earth Changes in Relation to the Point on the Earth at Which an Observer is Located. The Man at the North Pole, and the One in England Have the Same Time, While the Time of the Man on the Atlantic Ocean is Different from Theirs, and Also from the Man in Asia.

In Fig. 2 (Top Center) the Reason for Day and Night is Clearly Shown.

Fig. 3 (Top at Right) Gives an Idea of What the Earth and the Moon Would Look Like if Viewed from Space in Back of the Moon.

Fig. 4 (Small Left-Hand View) Depicts the Moon and Earth as Viewed from Space on the Same Side of the Earth as the Sun.

In Fig. 5 (Lower Photo) We Have a Partial Eclipse of the Sun by the Moon. The Moon is Just Shown Encroaching upon the Sun's Image, and Cutting off Some of the Sun's Rays from the Earth.

Fig. 6 (Small Right-Hand View) is an Actual Photograph of a Total Eclipse of the Sun. The Black Circle is the Moon, and the Irregular Light Ring is What is Known as the Corona, Formed by the Hot Gases Shot From the Sun.

Instructive "Movies" Show Universe

MOVIES have recently entered more than ever into the field of education, and have been found to give wonderful results in placing facts before pupils in a way that is easily understood and thoroughly memorized by them. Nothing, perhaps, is so well remembered as a picture.

We show herewith several photographs which are extracted from a series of films on popular science. The method of taking these photographs is quite unique and entails considerable detail work. In the first five figures, models are used to represent the earth, the moon and the sun, while Fig. 6 is an actual photograph of a total eclipse of the sun.

In taking the movies, all the models are arranged so that their movements may be controlled in absolute synchronism, that is, the distances between the earth and the sun are reduced in relation to their size, and when any of the models are moved to give certain effects, which effects are the same as those which actually take place in Nature, the distance through which they are moved is also demonstrative.

The models themselves are very carefully and accurately constructed of papier maché. By referring to the photographs, the reader will note that the details of the various continents, that is, the outlines and contours, are very beautifully worked out.

In the third figure, where a close-up of the moon is shown in the foreground, the reader will note how carefully the extinct volcanoes and lava beds are formed. This, of course, is done so as to give the much desired touch of reality to the film. It is hard to interest people in a scene in which a smooth sphere is supposed to represent the earth, etc.

An exceptionally good photograph is shown in Fig. 2, where the cause of day and night is shown. The side of the earth toward the sun is fully illuminated and in daylight, while the side away from the sun is dark, signifying night.

It is interesting to note that all light effects are secured by indirect or reflected light in order to give equality and softness to the models. In Fig. 2, just mentioned, the *sun* consists of a mirror, toward which a light is directed, and which reflects this light in such a way as to illuminate half of the *earth*.

In Fig. 4, the light which illuminates the earth and the moon is also reflected thereon, and is not direct light.

The stars which show as small dots in the sky in Fig. 5, are in reality small glass globes, which reflect the light, and give a true appearance of rotundity when projected on the screen.

This series of movies is meant to be shown in connection with a larger series on Commercial Geography. The idea is to show first the earth and the planetary system of the universe, and then to come closer and view the earth alone as a whole. In this way the pupils, before whom the films are shown, will grasp very quickly the earth's relation to the other heavenly bodies, and the pictures will prepare the way for a closer study of the earth.

The films to be shown in connection with those on astronomy, deal with the earth itself, its continents, and oceans, and their relation to commerce.

It is then shown why certain cities are located in certain places, that is, the relation of a city's site to the natural geographical resources is shown. In this way, the pupils are able to grasp at a glance the entire situation of commerce, and its relation to the geography of the earth.

Many of the effects which may be obtained from the use of these models, and some of our most difficult theories are more easily comprehensible, when illustrated by actual motion pictures. It is not at all strange that individuals entirely non-conversant in the English language, are able to grasp the meaning conveyed by these motion picture exhibitions. This fact was remarkably demonstrated by western engineers when they were training foreigners for road work in the construction of a new highway. To explain to each individual exactly what he was to do, would have taken hours of training, but with motion pictures, it was merely necessary to instruct the men to watch the operations, as performed by the moving models, and then to imitate those operations as nearly as possible in the actual road work.

It is evident that astronomically, the explanations of time, place and interplanetary space are very easily visualized in motion picture exhibitions, and by showing a close-up of the moon or Mars with the earth or sun in the distance, we are able to judge relative sizes and look down upon our earth from another planet. If we permit our imagination to stretch slightly at the same time, we wonder what our earth would look like if an astronomer at Mars were examining the surface of our planet.—*National Non-Theatrical Motion Pictures.*

Automatic Brake Control for Motor Cars

By H. H. DUNN

New Automatic Brake Control for Automobiles. When the Fender on the Front and Rear of the Car at E or D, Bunks a Pedestrian, a Circuit is Closed, and the Automatic Brakes Set Thru the Mechanism at A; B is the Usual Hand Brake. The Automatic Self-Setting Brake May be Cut Out by Means of the Push Buttons F, on the Dash. When the Automatic Brakes Set, the Engine Ignition is Cut Off, and the Horn Blows. The Bumpers are of Flexible Cable, so as Not to Injure the Person.

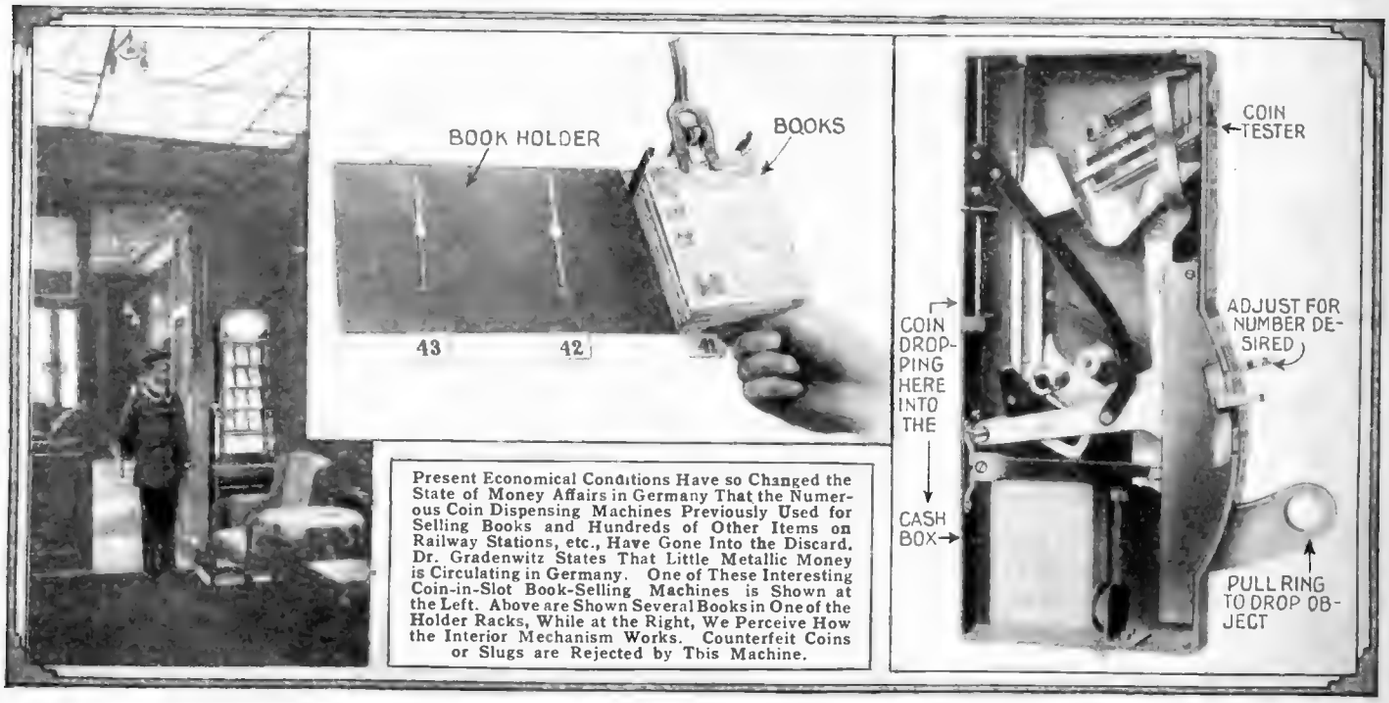
AN inventor of San Francisco, who has been at work for two years on the idea, has just completed a device to take the place of a bumper on automobiles, either passenger cars or trucks, and designed to prevent accidents, and to minimize injuries to pedestrians, at speeds of 15 miles or under, at which speeds some 62 per cent of all automotive accidents in the United States occur. The invention consists of two sets of contact bars, or cables, as may be preferred, stretched between two goose-necks, one of which extends from each knuckle of the car. The attachment is installed on both the front and

(*Continued on page 449*)

Automatic Book Vendors

By DR. ALFRED GRADENWITZ

GERMANY is, or rather *was*, the classical country of automatic vendors. At railway stations, hotels, restaurants, cafés, etc., those nickel-in-the-slot machines could be found, selling chocolates and sweets, tickets, stamps and postals, and a wide range of other articles, including soap and paper towels, or delivering a neat check with the person's accurate weight printed on it. We think our readers will be interested in the accompanying picture of one of them in operation. The machine comprises a choice of 12 different books, visible in some sort of show window, so that the would-be purchaser may select according to his taste, the more so as each volume bears a descriptive note on a wrapper. After adjusting for the number of the book selected and inserting the proper coin, he simply pulls the handle to the right in order immediately to cause the corresponding volume to drop out of the apparatus. The same selective vendors can, of course, also be used for other articles.



Present Economical Conditions Have so Changed the State of Money Affairs in Germany That the Numerous Coin Dispensing Machines Previously Used for Selling Books and Hundreds of Other Items on Railway Stations, etc., Have Gone Into the Discard. Dr. Gradenwitz States That Little Metallic Money is Circulating in Germany. One of These Interesting Coin-in-Slot Book-Selling Machines is Shown at the Left. Above are Shown Several Books in One of the Holder Racks, While at the Right, We Perceive How the Interior Mechanism Works. Counterfeit Coins or Slugs are Rejected by This Machine.

The Slot-Machine Radio

By H. GERNSBACK
(MEMBER AMERICAN PHYSICAL SOCIETY)

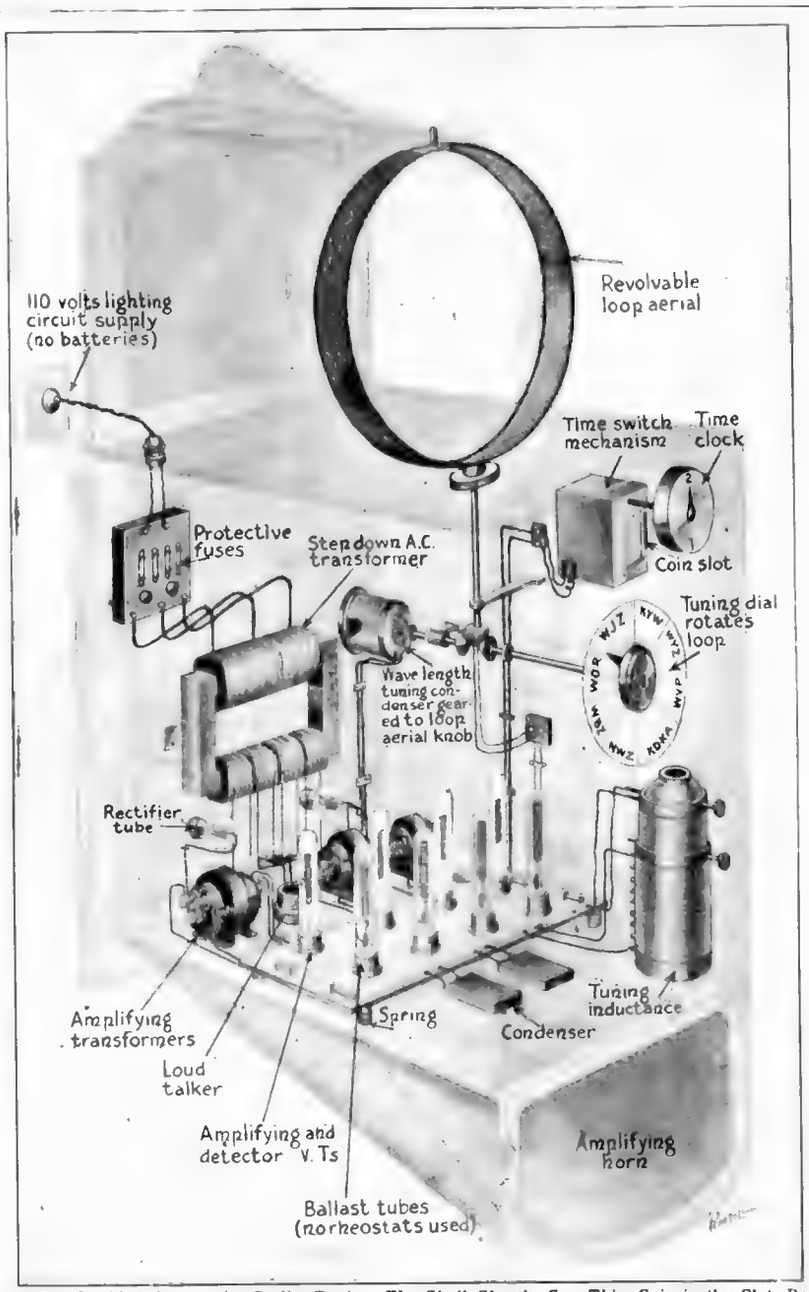
THE radio science is moving so rapidly these days that it is difficult to keep abreast of all its achievements. Moreover, we have become hardened to all the new wonders that are brought about by radio and we merely shrug our shoulders today when another development comes along. The latest addition to the radio family is a slot machine radio, which is now being developed by an eastern manufacturer. There was no reason, of course, that a radio slot machine could not have been built and manufactured for actual use five or more years ago. There was no demand for such a machine and none was produced. Today everyone is interested in radio, and with entertainments, from grand opera down to reports of prize fighting being broadcasted all over the country, such a machine is needed and demanded by the public.

There are, of course, various ways of constructing such a machine, and one example of its construction is shown in our illustration.

If a machine of this kind is to be used in any great quantity, for instance one in every suite of a 2,000-room hotel, the problem becomes complicated. In the first place, it is not possible to have an outdoor aerial for each outfit. Imagine the roof of one of our large hostelries equipped with 2,000 aerials! Plainly, such an idea, on its face, is preposterous. It therefore follows that we must use the loop system.

On the other hand, every radio receiving set is also a radio sending outfit, as is well known, and unless the correct steps are taken every loop will send out a wave of its own, interfering with other outfits nearby. By a correct filtering system, however, this can be done away with in such a way that there will be little interference between the various receiving outfits. Also the smaller the loop used, the less will be the interference between the different outfits. The small loop, as shown in our illustration, as well as on our front cover, would perhaps be ideal for work of this kind.

One of the most important points to remember in an appliance of this kind is that it must be fool-proof, and it must also be thoroughly practical. There must not be more than one knob or handle, and the adjustments must be all fixed in such a manner that the user will not have to change them once the set has started operating. Our illustration shows how this can be accomplished. In the first place, we have no batteries, either "A" or "B." The circuit is taken off a 110-volt lighting circuit, which may be either A. C. or D. C. If it is A. C., we need a transformer, as shown. We also need the rectifier tubes shown, which in a sense represent the "B" batteries. This system has actually been tested out by the Bureau of Standards, and it works. As for the arrangement of the circuits, we need not go very deep into this, for the reason that there are a number of hook-ups, and with a set of this kind we need at least six vacuum tubes, on account of the small loop used.



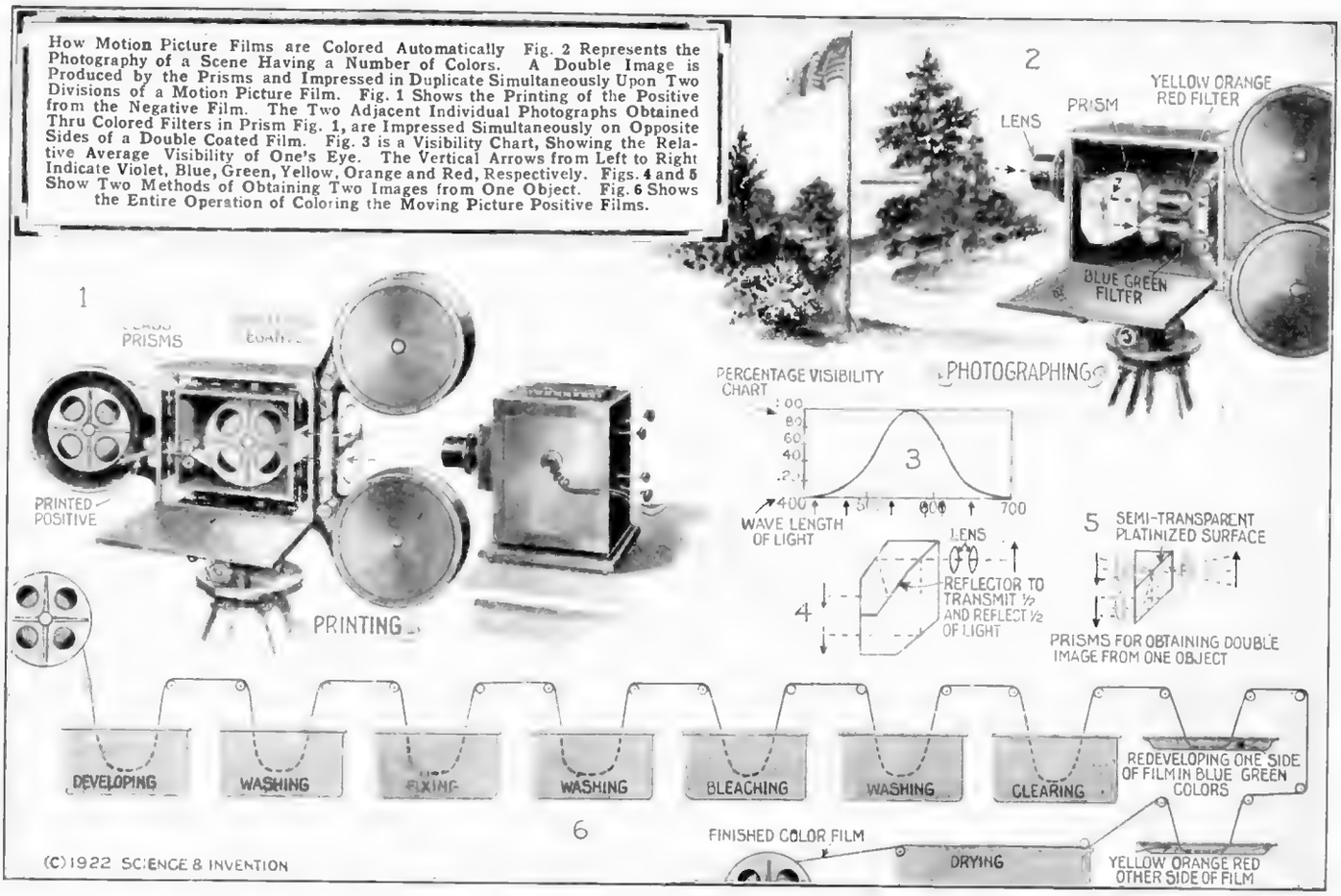
With the Rapid Advance in Radio Design, We Shall Shortly See This Coin-in-the-Slot Radio Receiver Installed in Hotels, Railroad Stations, and Other Public Places. All One Has to Do to Enjoy Any Variety of Music or Speeches Desired, is to Drop a Coin in the Slot, and Then Turn the Knob Until the Call Letters of the Station Which is to be Listened to Corresponds With the Index Pointer Shown, Which Turns the Geared Loop Aerial Toward the Selected Station. The Apparatus is Entirely Automatic and Operates From the 110-Volt Lighting Circuit Without any Batteries, as Described in the Radio Department of this Issue. Four of the Vacuum Tubes Shown are Ballast Tubes, Which Automatically Regulate the Filament Current to the Four Detector and Amplifying Audions, in Place of the Usual Hand-Operated Rheostats. The Audions are Lighted When the Coin is Deposited in the Slot. The Apparatus is Self-Contained and Easily Made Fool-Proof With the Present Knowledge of the Art.

The usual amplifying transformers and condensers (variable as well as fixed), can be seen in the illustration. A loud-speaking telephone receiver, as, for instance, the Baldwin type C, or any other similar means, can be used to connect with the lower horn from which the music or entertainment issues.

The tuning inductance shown is, of course, set and fixed when the instrument is first installed. There are, however, a number of taps left in order to make changes when new stations come into use, or if the wave lengths are changed. The Company's Maintenance Department would have to take charge of these things.

We now come to an interesting means proposed by the author, and which shows how, by a very simple method the loop can be turned by a center knob, and a certain amount of tuning done, all simultaneously. It is a well-known fact that if you receive from one station and then turn the loop to receive from another, a certain amount of tuning must be done; otherwise the entertainment will not come in at maximum strength. Very often the familiar whistling sound may be set up, which can not be avoided unless some tuning is done. The writer proposes to connect to the loop, by means of gearing, a sort of vernier condenser, which is placed in the circuit. This condenser is again geared, as shown, then by turning the front dial through quite a large angle, the shaft of the condenser will turn only a very small amount. Of course, the ratio of gearing has to be ascertained by experiments, as well as the positions of the stations plotted on the indicating dial. In practice, therefore, the dial would very likely be blank when the set leaves the factory. The Maintenance Department, when installing the outfit would then listen in for, let us say, WJZ. They would find a point where this station would come in loudest. They would then engrave the dial at this point with the call letters of that station, namely WJZ. Similar engraving would be done for other stations, so that the user of the instrument would have only to turn the knob to find the correct station, and where it would then come in at its maximum strength.

(*Continued on page* 515)


How Motion Picture Films are Colored Automatically Fig. 2 Represents the Photography of a Scene Having a Number of Colors. A Double Image is Produced by the Prisms and Impressed in Duplicate Simultaneously Upon Two Divisions of a Motion Picture Film. Fig. 1 Shows the Printing of the Positive from the Negative Film. The Two Adjacent Individual Photographs Obtained Thru Colored Filters in Prism Fig. 1, are Impressed Simultaneously on Opposite Sides of a Double Coated Film. Fig. 3 is a Visibility Chart, Showing the Relative Average Visibility of One's Eye. The Vertical Arrows from Left to Right Indicate Violet, Blue, Green, Yellow, Orange and Red, Respectively. Figs. 4 and 5 Show Two Methods of Obtaining Two Images from One Object. Fig. 6 Shows the Entire Operation of Coloring the Moving Picture Positive Films.
1
PRISMS
PRINTED POSITIVE
PRINTING
2
YELLOW ORANGE RED FILTER
PRISM
LENS
BLUE GREEN FILTER
PHOTOGRAPHING
PERCENTAGE VISIBILITY CHART
100
80
60
40
20
400
500
600
700
3
WAVE LENGTH OF LIGHT
4
LENS
REFLECTOR TO TRANSMIT ½ AND REFLECT ½ OF LIGHT
5
SEMI-TRANSPARENT PLATINIZED SURFACE
PRISMS FOR OBTAINING DOUBLE IMAGE FROM ONE OBJECT
DEVELOPING
WASHING
FIXING
WASHING
BLEACHING
WASHING
CLEARING
REDEVELOPING ONE SIDE OF FILM IN BLUE GREEN COLORS
6
FINISHED COLOR FILM
DRYING
YELLOW ORANGE RED OTHER SIDE OF FILM
(C) 1922 SCIENCE & INVENTION

Motion Pictures in Natural Colors

NOT so very long ago, most of the colored motion pictures which were exhibited on the American photoplay screen were artificially colored by hand. Most of these colored products came from France, where such coloring costs less than in America. It is a known fact that the individual frames or pictures in colored film plays do not vary enough to warrant detailed coloring by hand. Consequently, stencils can be made with which the coloring process is greatly speeded up. For instance, assume that we are viewing a scene of an automobile race track; the automobile will shift its position in each individual photograph, but the race track itself remains stationary. Therefore, in the coloring process, stencils are made which effected the tinting of the race track rapidly. The automobile alone is then colored by hand. A little later, processes employing colored screens became the center of attraction. In these the scenes were first photographed thru red, yellow and blue filters. The difficulty here was with the photographing of the scenes at three times the usual speed, and in the projection of these scenes at the same rate of speed thru corresponding filters. The filters were mounted on a circular disk, placed in front of or immediately back of the shutter. As this disk rotated, colored impressions were obtained upon the film in their respective intensities, dependent upon whether the red, yellow or blue filter appeared in front of the lens. Of course, the films had to be chemically treated in order to be responsive to light penetrating the red filter, and they had to be coated in such a manner that all three colors would affect the film in their proper relation, with approximately equal intensities. When the black and white positive film was then put into a projector equipped with revolving color screens, and the light was transmitted thru the film and colored disc upon the screen proper, at three times the usual speed, the reproduction of the image by the eye built up colors almost on par with those found in Nature, because of the effect known as retention of images or persistency of vision, which also makes the motion picture possible. The process was, however, very difficult to master, and operators thruout the country who did not take very good care of the film, or did not place the film properly in the machine, created thereby gross color peculiarities. So again, the moving picture industry fell back to the hand-coloring process.

Before further entering the "coloring of films" discourse, let us submit a few brief facts.

Sunlight is divided into 10 octaves—7 in the infra red, 1 octave visible to the eye, this octave creates the impression of visual light which includes the complete visual spectrum of color, 2 octaves in the ultra violet.

Silver salts, used in making emulsion for negative film, is barely sensitive to visible light. At the blue end of the spectrum approximately 1-16 of its sensitiveness is visible, 15-16 of its sensitiveness is in the violet and ultra violet part of the spectrum, which is invisible to the eye. By the addition of special dyes to the emulsion it is possible to increase the sensitiveness in the visible part of the spectrum so film known as Panchromatic negative is 3-16 sensitive to visual light and 13-16 to invisible ultra violet.

To photograph in color it is necessary to use special filters to eliminate all light except that visible to the eye. These filters must be so selected in color to create a photographic impression on the film in directly the same ratio as one sees.

Recently, a method of coloring motion pictures thru mechanical means, so that the colors are very vivid, and the equal of any found in Nature, or any which the artist could paint, has been placed upon the market, and the films are meeting a very satisfied audience. In this method, originated by Dr. W. H. Peck of New York City, a special camera is employed in the taking of pictures. This camera, equipped with only one lens, divides the light rays into two parts, thru prisms, so that the image which naturally appears on the film, occurs in duplicate. On one of these duplicates, the light rays pass directly thru a yellow-orange-red filter, on the other thru a blue-green filter, and the rays are received by two frames of the film simultaneously. The film then in the camera, instead of advancing one space at a time, as is the custom in ordinary photographic machines, leaps ahead two spaces, and as the shutter revolves, simultaneous impressions are again recorded on the film thru the two filters. The result is that instead of sixteen pictures per second, as is usual on negative films, the photographs obtained number thirty-two in the same interval of time. Of course, the impressions upon the film when it is developed are black and white negatives, one of which has been photographed thru the blue-green filter, and consequently will affect those parts of the scene which reflect either a blue or a green light, or any combination thereof, and will therefore, cause that film to show dense parts where there is intense green foliage, or very light parts, where red is prevalent. The other frame, photographed as stated before, will indicate the correct color values in black and white of those objects which have been photographed thru the yellow-orange-red filter.

(*Continued on page* 484)

Balsa Wood Iceless Containers

The New Balsa Wood Containers Here Shown May be Used for a Variety of Purposes, Including the Preservation of Ice Cream Without Ice for Periods Up to Twenty-Four Hours. A Standard Five Gallon Ice Cream Tub Packed With Ice Weighs Over 150 lbs., the Balsa Wood Iceless Tub, 100 lbs.

The Small Balsa Wood Cold Storage Containers Shown in the Lower Left-Hand Corner are Suitable for Auto Camping Parties, or for Taking Home a Quart of Ice Cream In, Without Resorting to Ice Packing. Refrigeration Pads are Frozen by the Ice Cream Maker, and These are Placed in the Balsa Wood Container With the Ice Cream or Other Food to be Preserved. Balsa is One of the Lightest of All Woods, Weighing but Ten Pounds per Cubic Foot, or Less Than Cork, as the Chart in the Lower Right-Hand Corner Shows. The Upper Left-Hand View Shows a Soda Water Counter, Four Compartment Ice Cream Tank With Refrigeration Pads.

NO longer is the man of the house, clad in evening clothes, requested to retire to the back porch to dig a can of ice cream out of a mass of salt and ice, nor is my lady, in party frock, to be splashed by the stream of water necessary to wash the salt off the extracted can!

Instead of the old, unsightly tub, dripping salty water on the floor, there now comes to the house mistress a box—light in weight—attractive in appearance—in which she finds in neat paper cartons, bricks of ice cream ready to serve on her table, or to be cut into separate portions in the pantry. No ice! No salt! No slop! All are done away with because Balsa—the wood of which the boxes are made—greatly retards the passage of heat. In other words it is a highly efficient thermal insulator.

Balsa is the wood of a tropical tree which may grow to 70 feet in height and 30 inches in diameter, but which is generally cut when the bole is 18 to 20 inches across. The logs are then sawn into planks which are carefully dried, treated to prevent decay, waterproofed, if that is necessary, and, like other woods, worked into the articles desired.

Because Balsa weighs only 10 pounds or less to the cubic foot, it has great bouyancy as well as insulating value, and these two properties have made it a popular material for life preservers, surf boards, decoy ducks, and a whole list of sports articles. Compare this weight with that of pine, 30 pounds per cubic foot, cork at 15 pounds per cubic foot and oak at 50 pounds per cubic foot. But of greater importance is the fact that, in spite of its extreme lightness, it is more than one-half as strong as spruce; hence it can be used structurally, and, in this particular it is unique among efficient insulators.

Balsa dry packed ice cream tubs will hold the well hardened ice cream for twenty-four hours without the use of ice and salt.

Balsa dry packed ice cream boxes can be made to keep ice cream hard for a twenty-

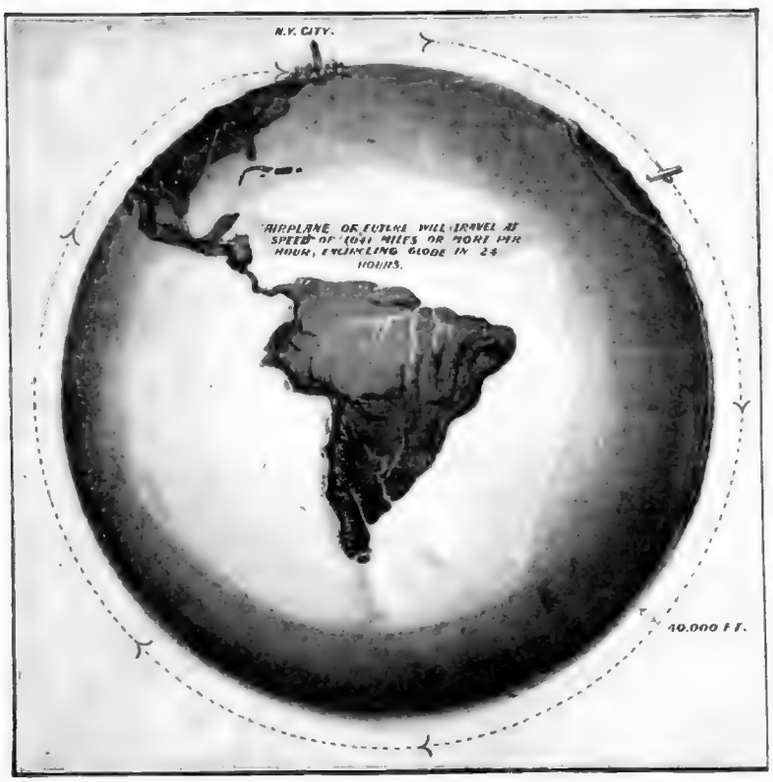
(*Continued on page 496*)

Flying Around World in 24 Hours

BEFORE the First International Congress of Aerial Navigation held at Paris, the celebrated airplane designer, M. Breguet, addressing the meeting of French scientists, said that he had plans for building an airplane which would be able to fly from Paris to Buenos Aires in three days, making only five stops on the way. The cost of the journey, he said, would, roughly, correspond with that of a first-class passage today on an ocean liner. The machine which M. Breguet expects to produce before many years have elapsed will have 1,200 horse-power and a speed of 253 kilometers (nearly 160 miles) an hour, and will weigh twelve or thirteen tons It will carry twenty passengers, one ton of baggage, a crew of seven and four tons of gasoline.

Continuing his address, M. Breguet traced the future development of flying at high altitudes with the turbo-compressor invented by Rateau, which enables engines to maintain their power in rarefied air. Basing his arguments on strict mathematical calculations, M. Breguet told of an airplane which, leaving Paris and flying at an altitude of 12,000 meters (about 7½ miles), would fly completely around the earth and return to Paris twenty-four hours later. The ultimate speed of machines flying at this height, he said, would be 800 meters per second (about 2,620 feet), which is greater than that of an artillery projectile.

Thanks to the New Turbo Compressor, Which Enables Aircraft Engines to Maintain Their Power in the Highly Rarefied Air Met With in the Upper Atmosphere, It Will be Possible For an Airplane Flying at an Altitude of 40,000 Ft. or 7½ Miles, to Fly Completely Around the Earth and Return to Paris, Its Starting Point, 24 Hours Later. "The Ultimate Speed of Aircraft Flying at This Height," said Mr. Breguet, "Would be 800 Meters per Second, or About 2,620 Ft. per Second, Which is Greater Than That of an Artillery Projectile."



Of What Are We Made?

IN the second part of Goethe's Faust, Wagner undertakes the task of making an artificial man and this homunculus is carried through several scenes performing his feats. Modern science has regarded this achievement as a dream for all time, after having determined that the body consists of an enormous number of complicated chemical combinations, which in the functions of life exist principally in the form of cells. Of what elements our bodies consist is clearly shown in the illustration here reproduced in which the successive factors are united one above the other into a sort of a synthetic image of a human being. At the very bottom of things we see that water, weighing from 90 to 170 pounds, represents the greater part of the weight of a man's body, exceeding the sum of all the other substances in such body. We next see carbon of one-half the weight of the water, which is the basis of the organic constituents of the body, such as albumen, carbo-hydrates and fats. Next comes ammonia, which supplies in great part the nitrogen contained in the albumen. Then come calcium carbonate, which builds up the major part of the bones, and phosphorus, which combines with calcium and oxygen to form calcium phosphate. Salt (sodium chloride) takes the next place, and is supposed to be dissolved in the water of the body, so it indicates the fluids of the body as a physiological solution of salt. Fluorine, familiar to us all in the mineral fluorspar, gives the bones and teeth their hardness; sulphur and potassium nitrate are also constituents of the albuminous substances of the body, and exist in hair, skin and nails. Of the other elements which only exist in small percentage, iron is especially interesting, as the element giving the red color to the blood, and which absorbs the oxygen of the air; arsenic, which imparts its tonic qualities to the system, and iodine, which is found in the thyroid gland and keeps the body in the condition of activity indicated by its temperature. The remaining elements appear to have very little effect on the system, but seem to be little more than a mixture, introduced into the body with the food.

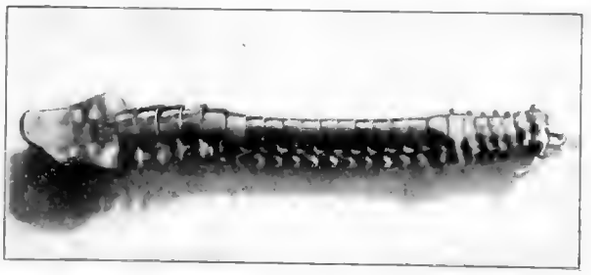
In the illustration here we have shown machinery for mixing the ingredients as they are fed into the hopper and properly forming them into the respective cells for the different parts of the body. Heat for the action is supplied by the blow-torch and the mixture is then cooled to the proper temperature before being permitted to pass through the opening of the funnel. Of course, such an effect is purely symbolic, and the desired result could not be obtained in the laboratory. Many investigators have, however, attempted to produce artificial life, some of them claiming they have had absolute success with their experiments and that they have produced one-celled animals which not only lived and fed, but actually multiplied. Such experiments are always interesting from a scientific view-point, as life itself always seems mysterious when one tries to discover its basic origin; all we learn is the structure of the body cells, and the synthetic composition of the cells.

Of What Are We Made? The Accompanying Illustration and the Table Below Give Some Idea of the Chemicals Used by Dame Nature in Building Our Bodily Structures. If Our Modern Scientists Possessed the Divine Secret of Breathing Life Itself Into This Mixture of Chemicals, We Could Then Actually Create Living Beings, But as Man Does Not Possess This Power, It Is Not Possible to Do So. However, It Is Interesting to Consider for a Moment the Different Kinds and Quantities of Chemicals That Go to Make up Our Physical Body.

Bromium Traces.
Copper Traces.
Lead Traces.
Arsenic 1 2000 grams .0308648 grains.
Aluminum, 1 g. = 15.4324 grains.
Manganese, 3 g. = 46.2972 grains.
Silicon, 3 g. = 46.2972 grains.
Iron, 5 g. = 77.1620 grains.
Magnesium, 50 g. = 771.62 grains. = 1.7635 ozs.
Saltpeter, 80 g. = 1234.592 grains = 2.82160 ozs.
Sulphur, 100 g. = 1543.24 grains = 3.527 ozs.
Fluorine, 100 g. = 1543.24 grains = 3.527 ozs.
Salt (Sodium Chloride) 250 g. = 3858.1 grains = 8.8175 ozs.
Phosphorous, 800 g. = 12345.92 g. = 28.2160 ozs.
Calcium Carbonate 1½ k.g., 162,140.2 g. = 52905 ozs. or 3.3069 lbs.
Ammonia 4 liters = 4.2268 quarts.
Carbon, 20 k.g., = 308648 g. or 705.4 ozs., = 44.092 lbs.
Water, 40 liters, 42.268 qts.

Metallic Model of the Spine

THIS model, just a little more than eight inches long, is not only unusually interesting as a curio, but presents marked qualities for teaching chiropractic students the fundamentals of their course. The whole is made up of aluminum and is complete from the axis and atlas clear down to the sacrum, the occyx not included. The foramen or openings for the passage of the nerve trunks are very clearly defined, as are the shapes of the cervical, thoracic and lumbar vertebrae; or, in other words, the appearance of the spinal column in the region of the head, chest and the lower back varies as it does in the human skeleton. Should any one of the vertebræ be removed from the entire group its position could almost instantly be determined. The bony column is very flexible, being mounted on a rubber hose, which represents the spinal cord, and transverse sections of rubber hose take the place of the nerve trunks where these are expected to make their exit. This model is used to demonstrate to chiropractic students effects produced by subluxations of the spinal bony structure and how proper adjustments should be made. Although the model cannot take the place of the individual bones in osteological studies, it occupies much less room than the "bag of bones" with which each medical student is supplied in his first year of study. This device was designed by Dr. A. J. Newman, of the New York State College of Chiropractic, who deserves considerable merit for this rather unusual construction. We trust that Dr. Newman will design an entire model of the osseous structure of the human body, including the head and the lower extremities; and that he will fasten the bones together as flexibly as in this model.

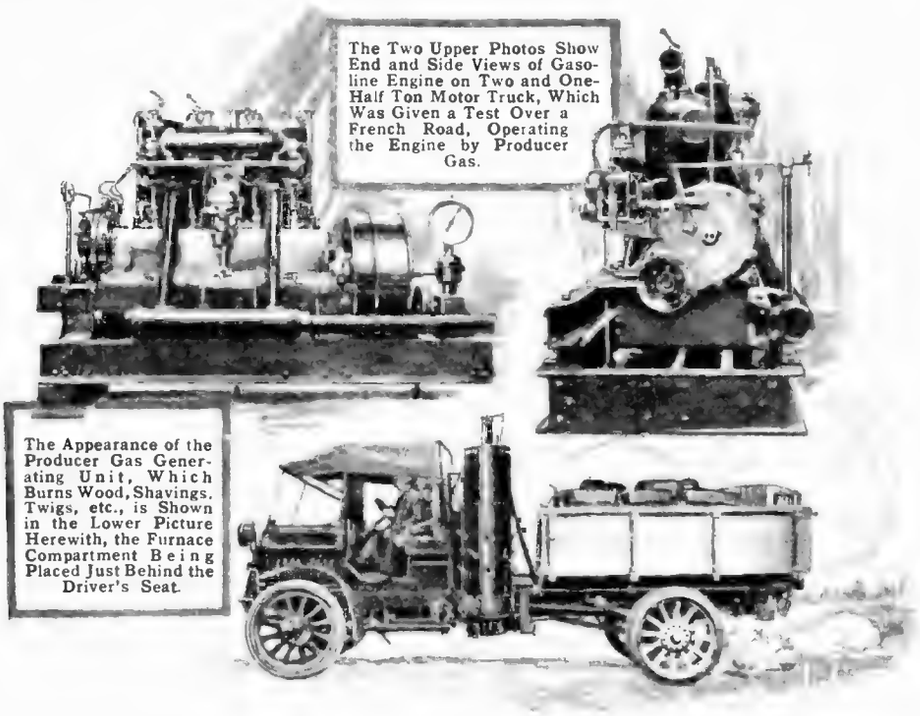


This Small 8½ Inch Model of the Human Spine Is Used for Demonstrating to Chiropractic Students the Effects of Spinal Adjustments.

Gas Producer for Autos

By E. H. LÉMONON

WITH engines using gasoline, the fuel costs can, apart from a lower price, only be reduced by a greater economy in its use. This does not appear very probable, as the internal combustion engine seems to have reached the limit of its economy for commercial work and further savings can only be looked for in the reduction of the weight of the vehicle in proportion to the load carried.



The Two Upper Photos Show End and Side Views of Gasoline Engine on Two and One-Half Ton Motor Truck, Which Was Given a Test Over a French Road, Operating the Engine by Producer Gas.

The Appearance of the Producer Gas Generating Unit, Which Burns Wood, Shavings, Twigs, etc., is Shown in the Lower Picture Herewith, the Furnace Compartment Being Placed Just Behind the Driver's Seat.

A recent practicable solution is in the employment of producer gas. That term is generally applied to gas made by passing water vapor, or steam, mixed with air thru a bed of incandescent solid fuel (coal, anthracite, coke, wood, charcoal, or brown coal, dried peat, etc.), whereby certain chemical actions take place and the gas is evolved. It has a much lower caloric value than what is termed *coal-gas*, which is produced by carbonizing bituminous coal in a closed retort.

First, pressure producers have been tried by some builders, but the results of the experiments were not encouraging. All the novel producer plants are now of the suction type, that is to say, worked by the suction of the engine to which it supplies the gas, or by a suction pump attached to the gas outlet and driven by some independent source of power. The pressure inside a producer of this type is always below atmospheric pressure, so any leakage would be of the air into the plant, not of gas outwards.

A very great point in favor of the suction type of producer is that as soon as the engine to which it is supplying gas is stopped production of the gas ceases.

Briefly, the arrangement of a suction producer plant is as follows: A chamber lined with firebrick is fitted with a fire-grate at the bottom opening into an airtight chamber termed the vaporizer, and containing water, which is heated by the combustion of the fuel. Thru this chamber air is drawn and becomes mixed with steam from the water. The steam and the air then pass up thru the fire and gas is evolved. A scrubber is generally attached to the producer and the gas is drawn thru this, is cooled and scrubbed and then passes to the engine.

The suction gas generator occupies considerable space and is very heavy. A 50 H. P. plant weighs about three tons. *Weight* and possibly *space occupied* are not very serious factors in stationary plants, but would quite debar the use of such producers for portable purposes. It is, therefore, interesting to note the progress made in an endeavor to overcome these disadvantages. The modern systems present serious claims to recognition in districts where gasoline is of high price and charcoal available at a reasonable price.

The *Cazes producer gas plant* works with charcoal and other kinds of small débris. It is claimed to be highly satisfactory with all types of engines from 10 H. P. to 60 H. P. The loss of power by the use of the Cazes producer gas plant in the same engine as against gasoline is not more than 20 per cent. and the total weight of the plant for an engine of 40 H. P. is 700 lbs. There is in addition the weight of the charge of charcoal and the supply of water.

The apparatus comprises the generator, a simple cylinder of 2 ft. in diameter, which is lined with fire-clay. It is provided with a grate at the lower extremity and surmounted by a hopper, the total height is 6 ft. Next to this is placed the regenerator, which consists of a tube lined with non-conducting material, and thru which passes a gilled pipe taking the gas from the top of the generator and passing it back into the bottom. The gas is drawn into the scrubber, a tube filled with porous material kept moist by a water drip. The gas next passes thru a condensing purifier, which is a box with a series of baffle plates, on which moisture is condensed from the gas. A small box filled with fibre, thru which the gas passes, serves the double purpose of preventing any solid particles passing to the engine, and act also as a safety device in case of backfires.

The engine receives its explosive charge thru a mixer placed near the carbureter. This is a contrivance having two butterfly valves controlling the proportions of gas and air, and another serves as a throttle for the mixture. The water tank, which in converted lorries is usually the former gasoline tank, supplies water to the generator to moisten the material in the scrubber.

A point which merits attention from a constructional point of view is the care exercised to prevent desintegration of the fire-clay lining of the generator by placing an intermediary elastic lining of non-conducting material between the steel cylinder and the fireclay core. Charcoal from the hopper is admitted as required to the cupola by means of a valve, so that the apparatus can be kept recharged without stopping the generation of the gas.

Coming now to the practical results which have been attained by the use of the plant on commercial motors, a load of over 13 tons, or 11,953 kilogrammes, on a trailer weighing 7.7 tons can be drawn by a tractor using producer gas.

The *Société Française de Matérial Agricole et Industriel* recently sent to Paris by road, from Vierzon (Cher) a lorry carrying a load of 2½ tons, which ran on producer gas. The illustration reproduced here gives a general view of the vehicle with the generator installed on the left side, behind the driver'

(*Continued on page* 501)

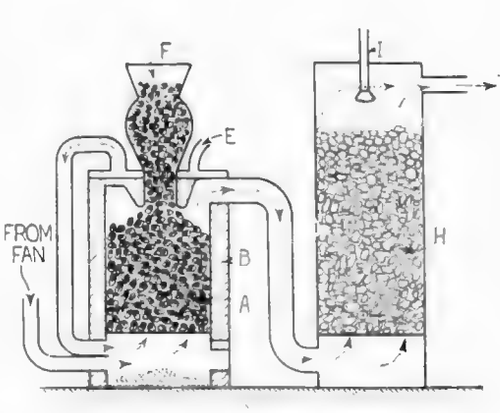


FIG. 1

Fig. 1—Simple Diagram to Explain Principle of Gas Producer Plant. A, Fire-Box; B, Refractory Lining; E, Air Inlets; F, Charging Hopper; H, Scrubber; I, Water Spray. (The Arrows Show the Direction of Air, Steam and Gas.)

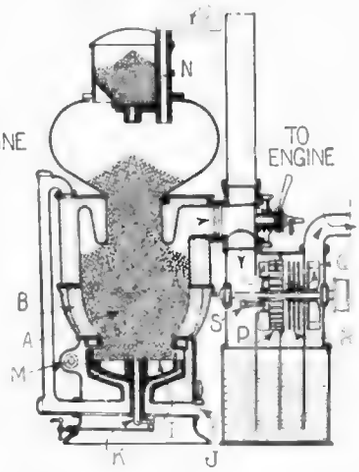


FIG. 2

Fig. 2—Gas Producer Used on French Car.—A, Fire-Box; B, Refractory Lining; I, Grate; J, Air Inlet; K, Rod Supporting Grate I, Which Acts as an Air and Steam Valve; M, Damper; N, Fuel Check-Valve Operated by Lever O; P, First Centrifugal Turbine; Q, Second Centrifugal Turbine; R, Set of Metallic Perforated Discs; S, Water Inlet to the Scrubber P, Q, R.

Why the Smooth Golf Ball Won't Fly Straight

By P. A. VAILE

EXPERT ON GOLF

IT is well known among golfers that the smooth golf ball will not fly straight, but the reason why it will not do so is known hardly to anyone.

Professor Sir J. J. Thomson, the famous British physicist, Cavendish Professor of Experimental Physics, Cambridge; Professor of Physics, Royal Institution, London, Professor of Natural Philosophy, Royal Institution, and winner of the Nobel Prize for Physics, 1906, personally assured me in a letter that he could give no scientific explanation of this curious and interesting phenomenon.

Professor Thomson, brother of the late Lord Kelvin, is the distinguished scientist who succeeded in splitting the atom, and, now, he is doing his best to cause the electron as much anxiety as possible.

On the 18th of March, 1910, he delivered his famous paper, "The Dynamics of a Golf Ball," before The Royal Institution, London, and in that lecture he does not even refer to the mystery of the flight of the smooth golf ball, so we may take it for granted that he does not hold the key to the mystery.

When a man of so great a reputation delivers a paper on such a subject before a body, which is admittedly the most learned in England, one cannot be accused of tackling an easy proposition, or one that is lacking in interest, when one essays to answer questions that Professor Thomson could not.

The first golf balls were made of hand-sewed bull's hide with the seams turned inside. This covering was then very tightly stuffed with feathers. Naturally these balls were not truly spherical or very well balanced, and they were very expensive.

About 1848 gutta percha was found to be suitable for making golf balls, and as they cost only about a fifth of the price of the old feather balls they soon grew in favor with golfers.

It was found however, that the new ball had the same defect that existed in the feather balls. It could not be relied on to carry straight.

One day, in disgust, a player gave several of his golf balls to his caddie. Some time afterward, happening to be short of a ball, he took one of these balls, that the caddie had been chipping around the caddies' quarters in practice, and found, to his amazement, that the flight was perfect.

This led to investigation. Soon it was established beyond doubt that a marked ball would fly farther and truer than one that was perfectly smooth or unmarked.

This led to a wide variety of marking, practically all by indentation, until the "pimple" or "bramble" marking was introduced. This has now gone out of fashion and in its place we now have the almost exclusively used dimple marking whose flight and general behavior seem to us, according to our lights today, to be almost perfect. What we now have to wrestle with is, why it will fly straight when the old feather ball and the smooth gutta percha ball would not.

"Coming to grips" with the matter at once we are aware that practically *nothing*, so far as we know at present, can fly *well* for any considerable distance without a tail.

What could we do with an airplane, an arrow or a kite without a tail, and a bird without a tail is, as all boys know, seriously handicapped. Even the modern rifle bullet, on account of its elongation and cross-spin, has almost been endowed with a caudal appendage.

Having got this idea of the necessity for having a tail into your mind let me ask you to look at the drawing of the golf ball in Fig. 1.

Here the golf ball is shown by the plain circle and it is being driven without any spin, in the direction shown by the arrow, from A to B.

It is, of course, natural that the air must be compressed considerably in front of the ball. This is shown approximately by the darker shading in front of the ball.

It follows also, quite naturally, that there must be something in the nature of a partial vacuum immediately behind the ball at the place marked C.

Now, the pressure of the ball on the air in front of it will be felt, let us say, as far forward as B. So at B we have the air at normal density. It then begins to be compressed until it is at the maximum of compression at A. It then *divides on a point* and flows round the ball, gradually losing its compression, as shown by the lighter shading, until it regains what we may call normal density, at or about the point D.

We thus see that the ball is traveling in what we may regard as a cylinder of compressed air of varying degrees of force throughout its length, but being greatest in front of the ball, and, after that, decreasing until it is lost in normal density at D.

It is quite obvious that, unless the division of the compressed air at A, takes place very exactly, there will be a tendency for the ball to get pushed to one side or the other.

Some time ago I produced and sold to the United States Rubber Co., for the princely remuneration of $250, and three rather good cigars, which I took instead of another $250 which was to have been paid to me, a design called "The Waviline."

This consists of an indeterminate mark ing that permits the free ingress and egress of the air at the same depth *in the ball's cover* all the time, instead of setting up a multitude of miniature battles on the ball's cover during its flight.

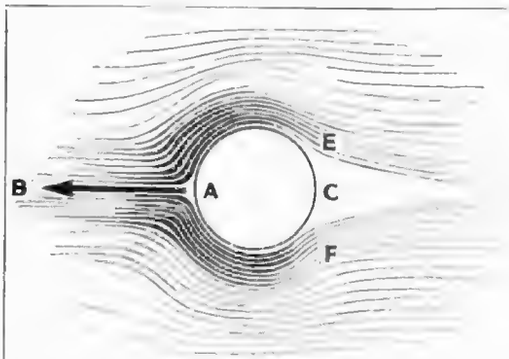
The dimple marking design is as surely doomed to go as was the pimple. There is not one solitary scientific argument to be put forward in favor of determinate marking, that is, individual marks, as opposed to continuous grooves. If anyone should feel contentious in this matter let him ask an airman, "If you had to make a series of indentations on the leading edge of your plane and back for a foot or two would you make continuous grooves or would you carve out individual cup-shaped hollows?"

Turning again to a consideration of Figure 1 we may remark on one aspect of the ball's flying in this "tube" or cylinder of compressed air, which, in effect, provides it with its missing tail, when properly held to its course by suitable marking, that has not, so far as I am aware, ever been considered in the flight of a spherical projectile, and that is the action of the vacuum behind the ball.

I know that it sounds funny, but it will not do so to the airman who knows that the upper part of his wing, or the area of negative pressure, does about 66 per cent of the lifting.

Looking again at Fig. 1, you will see that the air at E and F is still compressed and that it, therefore, is doing to the golf ball exactly what you do when you "fire" away a melon seed by squeezing it between your thumb and forefinger. I cannot in the space at my disposal compute this force, but it is there.

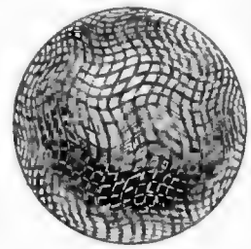
"Boiled down," we might say that the reason the marked ball will fly better than the smooth is that the indentations set up more friction, especially laterally, and so counteract, better than can a smooth ball, any attempt to push it sideways that comes from defective center of gravity or unequal dividing or density of the compressed air current on the front portion of the ball at the point A.



Smooth Golf Ball in Flight, Showing Tail C, Practically a Vacuum Pocket, Also How the Air Splits and Divides on Either Side of the Ball. If There is the Least Bit of Unbalance in Such a Smooth Ball It Will Travel an Untrue Path, Because the Air Passing Around the Ball Cannot Get an even Grip on It. Fig. 1.

The Ordinary Dimple Marking of a Golf Ball—an Effort to Make It Fly Straight. This Design Does Not Permit of an Even Flow of Compressed Air Around the Ball, as Mr. Vaile Points Out in His Article.

Mr. Vaile Suggests an Improved Design Above, Where the Indentations on the Golf Ball are Joined by Little Canals, so as to Permit a Fairly Continuous Passage of Compressed Air Around Either Side of the Ball.

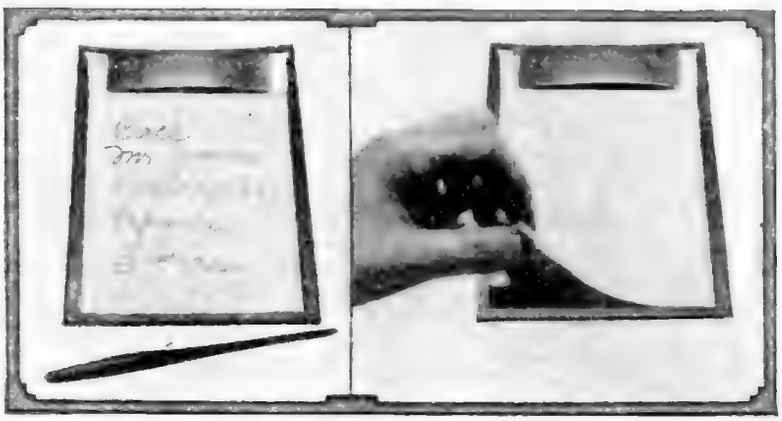


This Shows the Perfect Design of Golf Ball Suface, as Developed by Mr. Vaile, and Known as the "Waviline" Pattern. As Will Be Seen, it Comprises a Continuous Series of Criss-Cross Grooves of the Same Depth and Width.

Memorandum Pad Everlasting

A DESK memo pad is one of the potential powers in the busy man's day.

The illustrations herewith show the latest idea in everlasting memo pads — one upon which the writing is done by means of a blunt pencil, having a rounded steel point, and this pad requires no renewal paper, tablets, etc. Its secret lies in the fact that a thin coating of paraffin wax is placed over a dark surfaced bottom on the table, while over the paraffined layer is placed a piece of tracing paper or rather cloth. When written upon with the steel pencil, the writing becomes visible owing to the action of the wax holding the cloth or paper down tightly, and causing the dark surface behind it to show thru. When the memorandum is no longer desired, the writing is *wiped off* simply by lifting up the paper, the action being quite magical indeed.



New Memorandum Pad From Which the Writing is Eradicated by Simply Pulling Up On the Paper Sheet.

Machine Mills, Drills and Grinds

By ALLEN P. CHILD

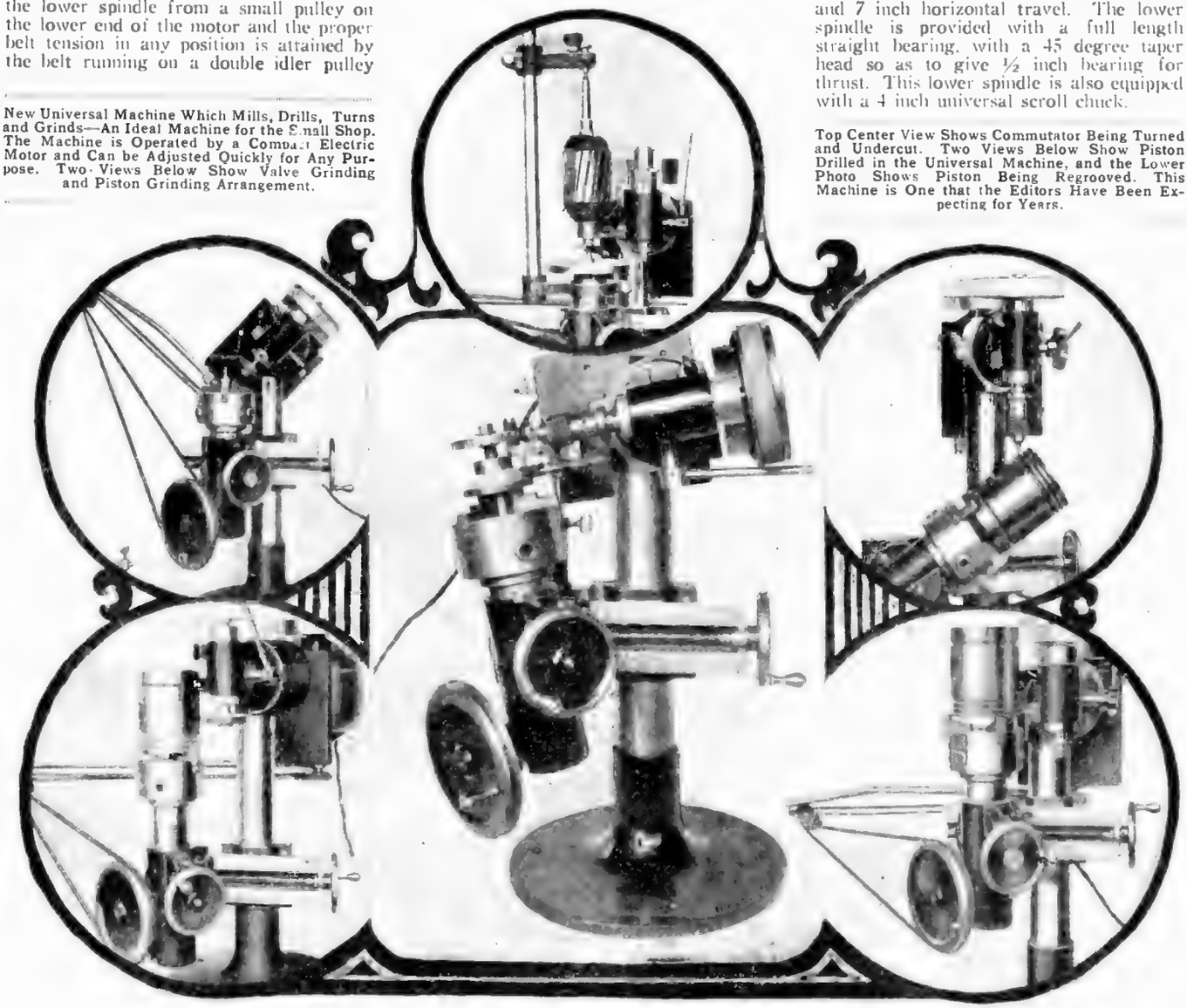
THIS universal bench machine is a recent product of a Detroit manufacturer and might be considered a complete machine shop equipment for the use of small shops where production is not the great requisite. In this machine the upper spindle head can be set at any angle about a horizontal axis as it is directly connected to the ¼ H.P. motor. The lower spindle can be set at any angle desired, as well. It is possible to drive the lower spindle from a small pulley on the lower end of the motor and the proper belt tension in any position is attained by the belt running on a double idler pulley fastened to a spring on an adjustable shaft.

Grinding operations, both external and internal, may be accomplished with this machine as well as any class of cutter grinding. The grinding range is such that holes as small as $^{5}/_{16}$ inch in diameter may be ground as readily as the outside diameters of automobile pistons. Small turning operations such as regrooving of pistons and the turning of small armatures may be conducted by inserting a tool in the lug to the left of the upper spindle. By placing a drill chuck in the place of the abrasive wheel on the upper spindle small drilling or milling operations may be done. For this purpose a large pulley is used to reduce speed.

The upper spindle has 1½ inch travel, the lower spindle has 2½ inch vertical travel with 8¾ inch vertical adjustment and 7 inch horizontal travel. The lower spindle is provided with a full length straight bearing, with a 45 degree taper head so as to give ½ inch bearing for thrust. This lower spindle is also equipped with a 4 inch universal scroll chuck.

New Universal Machine Which Mills, Drills, Turns and Grinds—An Ideal Machine for the Small Shop. The Machine is Operated by a Compact Electric Motor and Can be Adjusted Quickly for Any Purpose. Two Views Below Show Valve Grinding and Piston Grinding Arrangement.

Top Center View Shows Commutator Being Turned and Undercut. Two Views Below Show Piston Drilled in the Universal Machine, and the Lower Photo Shows Piston Being Regrooved. This Machine is One that the Editors Have Been Expecting for Years.



A Player Cornet

Master Barrie Darewski Playing the Latest Mechanical Cornet. Mr. Darewski Sr., Has Acquired the World Rights to This New Device—the Player Cornet.

PLAYER pianos have been with us for many years, but the latest idea in automatic playing musical instruments is the player cornet here illustrated in use by Master Barrie Darewski, youngest son of Herman Darewski, noted music composer. The secret of the instrument lies in the special perforated paper roll, which is employed for each selection to be played, and the simple act of blowing into the cornet mouthpiece, causes the perforated paper strip to work its way through the valve mechanism, and thus sound the notes.

A New Tooth Brush

The Illustration Shows a New Form of Tooth Brush With Which All the Surfaces of the Teeth, Both the Back and Front, May Be Cleaned Thoroly. The Brush Is Designed With a Pivoted Handle to Facilitate Thoro Cleaning of Both Front and Side Teeth. The Handle and Brush Are Separable and Refillers May Be Obtained.

IN the illustration herewith is shown a new form of tooth brush, with which all the surfaces of the teeth may be cleaned simultaneously and in the proper way. The design of the brush is unique in that the brush proper is pivoted on the end of the handle instead of being fastened rigidly thereto. This permits the use of the brush at all angles without a corresponding inconvenience in handling it.

The handle and the brush are separable, and refillers may be obtained which is the same as purchasing a new brush with the exception that the same handle is used.

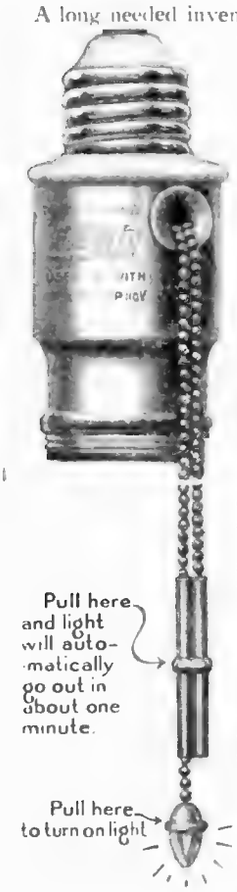
The bristles used are of first quality, and each tuft is trimmed to a sharp point to insure a perfect cleaning of the spaces between the teeth.

The refillers are sterilized and sold in a sealed container, three in a box, and will be found very useful and economical, as they may be purchased in different grades.

In use, the brush is placed over the top or bottom row of teeth, and pushed along them, at the same time tilting the brush from side to side, allowing the celluloid ends to gently massage the gum.

Automatic Socket

A long needed invention is shown in the cut. This socket automatically interposes a brief interval of delay between the act of switching off a light and the actual circuit breaking movement of the switch which extinguishes the light. The device works otherwise like an ordinary switch, the lamp being lighted the instant the switch is turned on.



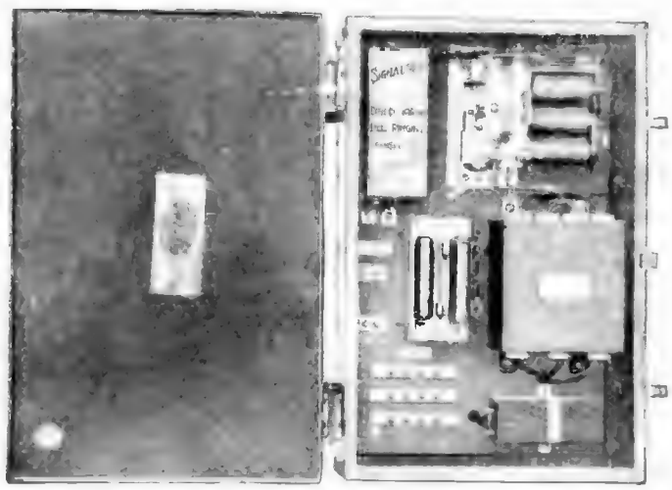
The first form of socket switch to be put on the market is a pull socket of the attachment style, which can be inserted in any medium base socket outlet and works with an ordinary lampbulb.

The delay-causing agent is the thermostatic element, recognized in engineering fields as absolutely dependable and permanent in operation.

This pull socket makes possible the convenience and safety of leaving a fully lighted room. It serves the full purposes of expensive wall switches and is even more convenient, for the light still shining from the room one is leaving enables him to see his way to the light switch of the room he is about to enter.

D. C. Bell Transformer

It seems an anomaly when a house or office, wired for a direct current, from a 110 or 220 volts potential, relies upon inefficient dry batteries to operate its bells, buzzers, and other signaling apparatus. The apparatus we describe, by means of a pole changer and step-down transformer, takes off an alternating current from either of the circuits mentioned, reducing the potential to both 10 volts and 20 volts in the one apparatus. This low voltage together with the protecting elements of an alternating current system operating electro-magnetic apparatus, makes it a perfect substitute for the dry battery, and more than this it is to be considered a very great advance thereon. A kilowatt-hour of energy obtained from dry batteries may cost several dollars. The figure of sixteen dollars is even given as a possible figure. When power is bought from the public service company, the average maximum rate is 10 cents for the above quantity—quite a difference.



Something Needed Badly—a Direct Current Bell Ringing Transformer. Compact and Well Built. It Is Suitable for Large or Small Bell Installations.

It is not only a question of economy but of convenience. It is most annoying to find batteries suddenly weakening, so that they have to be replaced to put the signaling system in order. The first notification received of the breaking down of the system, is often the complete cessation of the operation, so that everything stops until a new battery is installed. Each of the apparatus has two secondary potentials, 10 and 20 volts, thus doubling its range of capacity. A single dry cell is used to close a relay, which takes so little current, that the battery will last for many months.

We are only beginning to fully use the public service electrical supply.

How Bones Grow

By C. M. LANCASTER, D.C. Ph.C.

How Strangely Similar to the Growth of Bone is the Appearance of Coral. If Coral is Sectioned it Will Look Just as Porous as Natural Bone. Growths Similar to the Canals in the Bone Will be Observed, Particularly When the Coral is Placed in a Fish Bowl As Here Illustrated and Examined from the Outside of the Globe. The Water Lens Formed by the Bowl of Water Not Only Adapts Itself to the Continual Change of View of the Observer, But Also Acts as a Magnifier, Permitting Small, Yet Quite Accurate Magnification, and Enabling the Object to be Viewed More Distinctly.

ALL school children remember the explanation of the formation of coral. How, unguided, it deposits minute cells, which give up their life and become ossified or petrified into tiny, porous, plant-like shapes. Closely examined, these deposits have the appearance of bone which has been dried or in what is known as the macerated condition. Take for comparison preferably a cross section of bone from which the organic matter has been burned away and tiny cells or pores much like the coral will be found. It will be seen that in the coral, the cells, after being built up, become dead matter, while in bone the cells becoming living organic tissue, capable of being sustained by means of blood vessels which pass thru the small canals carrying nourishment to them and absorbing from them red blood corpuscles. Bone is wonderfully made and considering that 50 per cent. of it is water, its great strength is really marvelous.

Bone is ever building or changing, hardening into more calcareous material until in old people it becomes very brittle, but in childhood and youth the cartilaginous cushions are so constructed that the uncompleted growth is protected during the most active period of our life

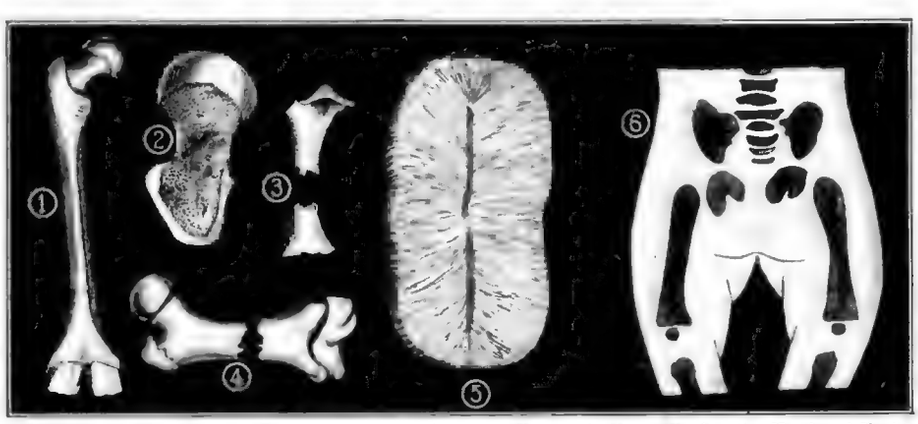
Upon examining the cross section of a porous bone the similarity to coral will be readily observed. Noting this feature of porosity in the coral connected with its extended reflection in a glass goldfish bowl, it will be very interesting to watch the changing of these pores into lengthening columns and upreaching and down dipping extensions which finally unite, as in the bone, and take their places as columns. shown above. It will be seen by a closer observation that the reflection of the coral is considerably magnified and offers a continuous change of view to the observer owing to the water lens in the bowl adapting itself to the vision of the observer. A change in the angle of vision produces a different aspect of the growth. When the angle is adjusted to the focus of the individual, the small projections cause the coral to take on the appearance of a longitudinal section of bone in which the spicules advance, resembling actual growth at an apparently high rate of speed. It must be remembered that in life this apparent growth would require many months. Examination of the accompanying figures will prove very interesting to students in X-ray work. Fig. 1 shows the femur which is the largest bone in the body. The picture, Fig. 6, is drawn from an X-ray taken at birth. Notice the points where it later unites with the skeleton; not even the articulations are yet formed and it is also separate from the epiphysis of the knee bones, which have not as yet been formed. The femur develops very slowly uniting with the skeleton at the eighteenth year.

The other figures, 2 and 5, illustrate the similarity of soft, bony tissue to coral formations; 3 and 4, the femur under various stages of development.

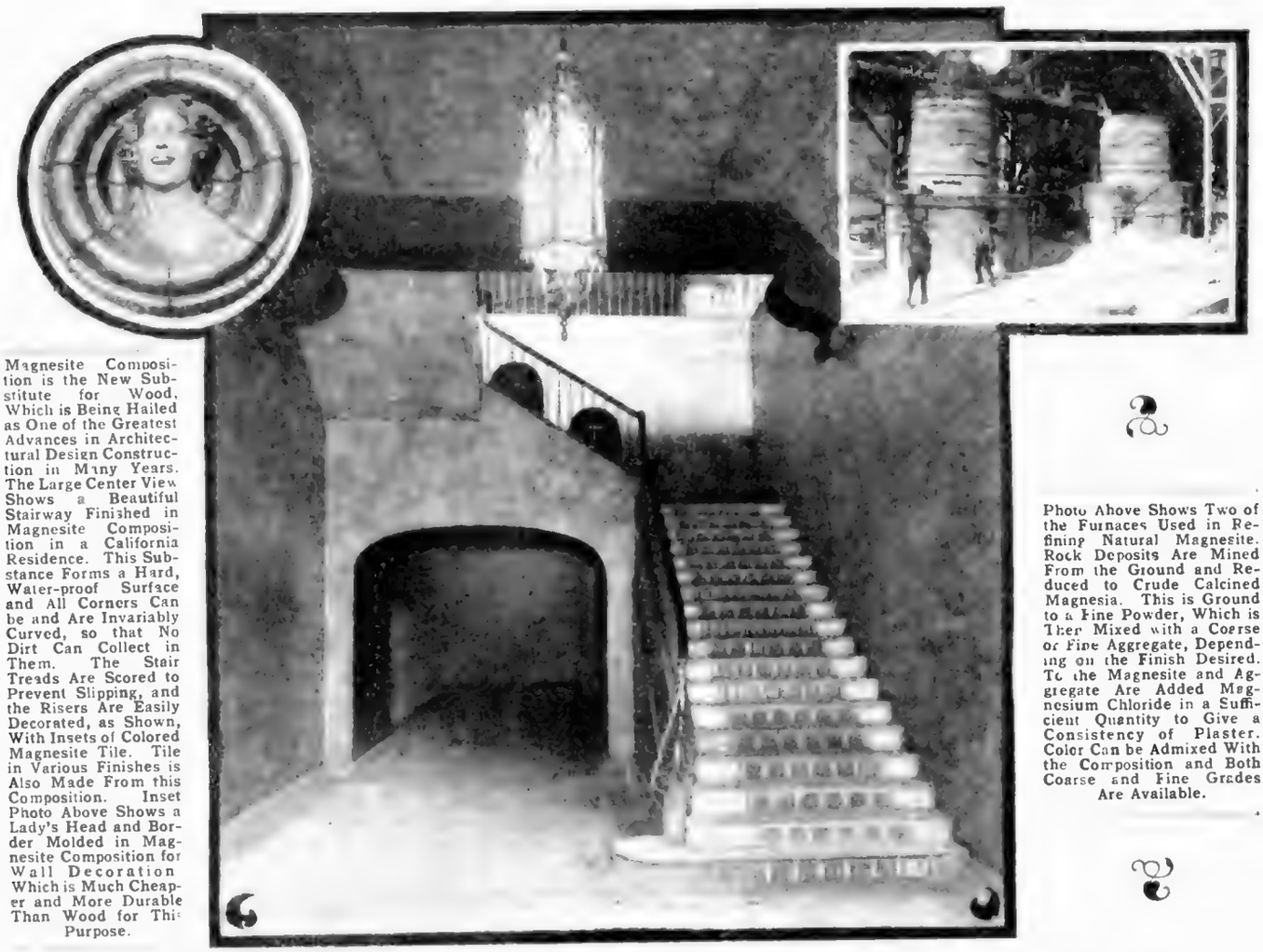
Electrical experimenters may see in the variety of coral known as *mushroom coral* (Fig. 5), the septum or spine which as the corpus collosum divides the brain of man, separates the two halves of the coral formation, regardless of whether its shape is round or oval. These halves are more securely united at the point where this septum exists. From its line flow other formations like the spinal nerves from the spine of man. These take the symmetrical shapes which have to do with the outward form of the coral structure. Liken it to the two poles of a magnet and associate if you can some governing force directing the manner in which the tiny coral insects shall so deposit themselves as to leave so wonderful a monument of their life work.

It is interesting to note that the skeleton in the adult consists of 200 distinct bones. There are 26 in the spine and vertebrae, including the sacrum and coccyx. The cranium contains 8, the face 14, the hyoid, sternum and ribs 26, and the upper extremities 64, while the lower contain 62 bones. In this enumeration the patellae are classed as separate bones, but the smaller bones in the ear and the sesamoid bones are not so included. Every bone in the body is of course subject to fracture, some more so than others. There are two types of bones developed in passing from the embryonic to adult life, bone tissue itself appearing relatively late in the embryo. Thus we have the membrane bones of the face and cranium and the cartilage bones which replace the cartilaginous skeleton of the adult. These cartilage bones are not simply transformed from cartilage by the deposition of calcium salts, but represent new tissue which is developed as the cartilage is destroyed. If bone is injured or fractured, new bone is developed by the osteoblasts or bone-making cells, derived either from the periosteum (the sheath surrounding the bone), or from the bone marrow. This repair of the fracture is usually preceded by the formation of cartilage (knuckle-like structure), which unites the ends of the bones, and is subsequently changed to bone. In the adult the periosteum, more so than the bone marrow, causes the regeneration of the bone tissue. It is strange that bone is rather rapidly repaired in children and young adults; but the knitting of bone is rather difficult after life has proceeded for forty or more years, although strange incidents sometime occur. For instance, there is a case on record in which a woman 82 years of age fractured both legs and one arm; eight weeks later she was quite well and about.

(Copyright by Author)



The Femur, or Long Bone of the Body, is Here Shown at No. 1. At No. 2 We See the Head and Neck of This Bone Cut Away to Show the Soft Bony Cellular Formation. At No. 3 is the Femur Just Before Birth, and No. 4 Illustrates the Epiphysis of the Bone Uniting with the Shaft (the Epiphysis is the Round Knob or Head). At No. 5 We Show the Lace-Like Formation Found in Mushroom Coral, Remarkably Similar to the Structure of the Human Bone, and Fig. 6 is an X-Ray of a Child at Birth. This Illustrates the Frail, Incomplete Skeleton Found in Infants.



Magnesite Composition is the New Substitute for Wood, Which is Being Hailed as One of the Greatest Advances in Architectural Design Construction in Many Years. The Large Center View Shows a Beautiful Stairway Finished in Magnesite Composition in a California Residence. This Substance Forms a Hard, Water-proof Surface and All Corners Can be and Are Invariably Curved, so that No Dirt Can Collect in Them. The Stair Treads Are Scored to Prevent Slipping, and the Risers Are Easily Decorated, as Shown, With Insets of Colored Magnesite Tile. Tile in Various Finishes is Also Made From this Composition. Inset Photo Above Shows a Lady's Head and Border Molded in Magnesite Composition for Wall Decoration Which is Much Cheaper and More Durable Than Wood for This Purpose.

Photo Above Shows Two of the Furnaces Used in Refining Natural Magnesite. Rock Deposits Are Mined From the Ground and Reduced to Crude Calcined Magnesia. This is Ground to a Fine Powder, Which is Then Mixed with a Coarse or Fine Aggregate, Depending on the Finish Desired. To the Magnesite and Aggregate Are Added Magnesium Chloride in a Sufficient Quantity to Give a Consistency of Plaster. Color Can be Admixed With the Composition and Both Coarse and Fine Grades Are Available.

A Substitute for Wood

By PERSIS BINGHAM

MAGNESITE is a material possessing properties of such diverse natures that it may be used as a building material in a home in so many widely different ways that no layman will recognize it as the same substance. It is primarily magnesium carbonate, which, under various trade names, now enters into the construction of homes, hotels, restaurants, bakeries, railroad depots, country clubs, office buildings, factories and even ocean steamships. Its uses are legion; in one form or another it has served as floor, wall, roof, stairway, drainboard, sanitary base, shower enclosure, bath tub encasing, fireplace tile, ornamental wainscoting, countershelf, medallion and fancy entrance name plate over a soft drink emporium.

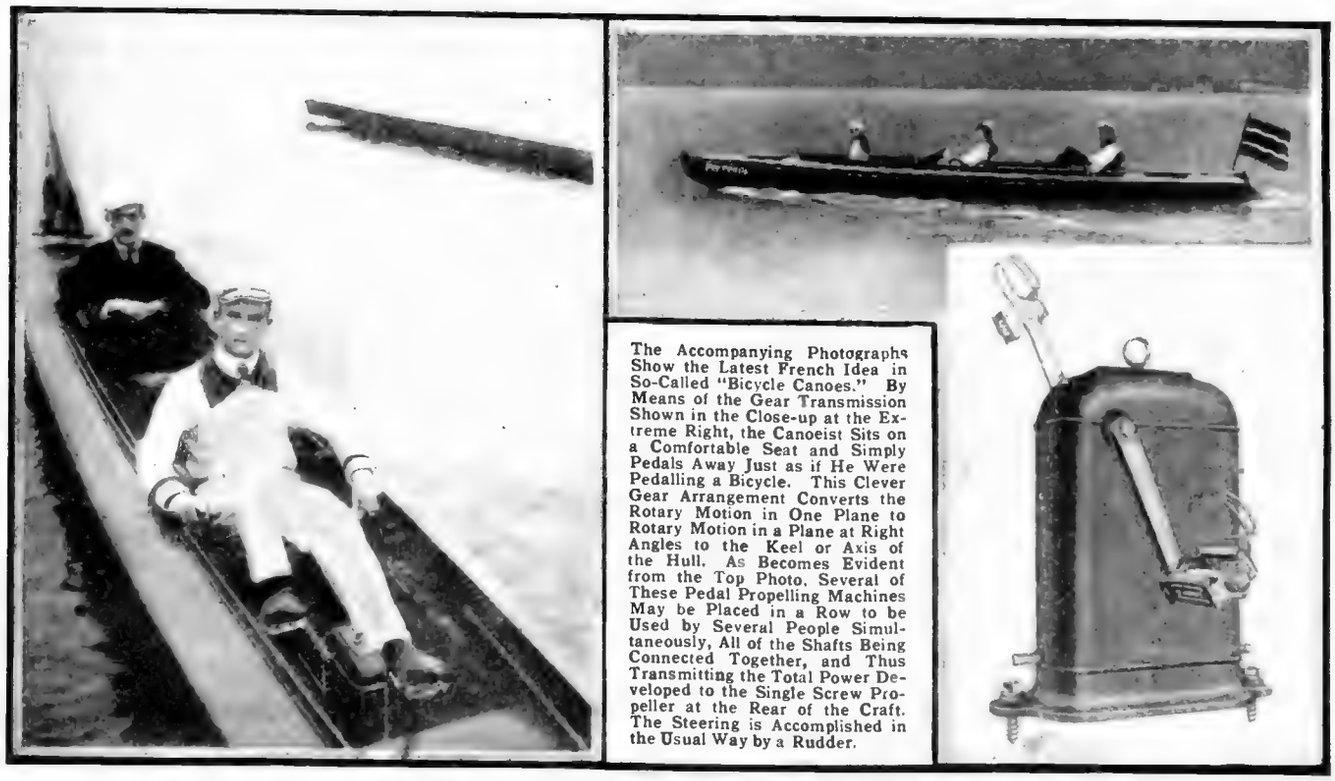
The Samson quarries on Samson Peak, San Benito County, California, produce large quantities of natural magnesite. Rock deposits of it are taken out of the mountain, ground and reduced to crude calcined magnesia. This must be ground to a fine powder, almost white in color. With this powder is mixed a coarse aggregate when the first or *scratch coat* is to be made; a fine aggregate for the finish work. To the magnesite and aggregate are added magnesium chloride in sufficient quantity so that a mixture about the consistency of plaster is obtained. When floors, walls, drainboards, stairways or any other monolithic surface is to be made, this moist composition is applied with a trowel to a foundation which has had its surface roughened or covered with small mesh chicken wire on regular metal lath. Usually the work is done in two coats. When color is desired, this is mixed with the finish coat.

One of the first uses to which magnesite composition was put in the building line was the covering of wooden drainboards in the kitchen. Wood is never a satisfactory material where water must be frequently applied. Marble and opalite are too expensive for the small house, but magnesite composition is of moderate price, thoroughly waterproof, its surface smooth as glass and very hard.

The success of the drainboards induced far-seeing builders to try out magnesite floors in the kitchen and bath. These also proved so popular that materials and workmanship were experimented with and improved upon until now two and three tinted floors in patterns can be turned out of such a high quality that clubs, banks and office buildings use them extensively. The surface is not so hard on the feet as cement or tile, and being impervious to water, is more permanent than wood. The first magnesite floors were laid directly on foundations of cement or roughened wood, but now the foundation is covered with a resilient material before the magnesite is laid, which insures a surface as springy to the step as a soft carpet. Frequently a magnesite border is used with a linoleum center; by inlaying strips of magnesite, a large floor of this kind may be covered without a seam. As the magnesite seals the edges of the linoleum and prevents deterioration, the life of the latter is materially increased. By using the resilient undercoat the linoleum becomes as comfortable to the step as a padded Brussels carpet.

As a stair material magnesite achieves one of its greatest triumphs. It is waterproof, sanitary, hard and lasts indefinitely. Cleanliness is one of the first requisites of a stairway, public or private, and this is comparatively easy with a waterproof surface on which all curves have been rounded so that no dirt can collect there. On public stairways the treads are scored to prevent slipping, and the risers decoratively treated with insets of colored magnesite tile, as shown in the attractive lobby here illustrated.

Next to the monolithic form of covering, the most popular is the unfired tile. These tiles can be made any size, pattern, color, shape or design, either flat or molded. Their method of manufacture is similar in its first stages to that of the kiln-fired product, but no heat is applied. A mold is cast and the magnesite mixture is poured into it to set. Sometimes color is applied after the tile is dry, sometimes liquid pigment is added to the moist mixture. Any gradation of tint may be achieved with a fair amount of accuracy as the tile does not have to be fired, which process usually involves a change of color. Unfired tiles are not brittle and possess great tensile strength, even resisting hammer blows without cracking or chipping. These tiles are used for fireplace facing, ornamental wainscoting and insets or wherever ornament or pattern are desired.



The Accompanying Photographs Show the Latest French Idea in So-Called "Bicycle Canoes." By Means of the Gear Transmission Shown in the Close-up at the Extreme Right, the Canoeist Sits on a Comfortable Seat and Simply Pedals Away Just as if He Were Pedalling a Bicycle. This Clever Gear Arrangement Converts the Rotary Motion in One Plane to Rotary Motion in a Plane at Right Angles to the Keel or Axis of the Hull. As Becomes Evident from the Top Photo, Several of These Pedal Propelling Machines May be Placed in a Row to be Used by Several People Simultaneously, All of the Shafts Being Connected Together, and Thus Transmitting the Total Power Developed to the Single Screw Propeller at the Rear of the Craft. The Steering is Accomplished in the Usual Way by a Rudder.

A Bicycle Canoe

NAVIGATION on the water is accomplished in many ways. We actually know a whole series of mechanisms, which use the movements of bicycle pedals to transmit the power for propelling the apparatus. All kinds and methods of propulsion are used, including ordinary screws, paddle wheels, endless chains with paddles and ordinary oars, imitating the movement of the oarsman. The propeller has always been used for hydrocycles. The original model is that which employs the movement of automobile pedals for driving the screw and the canoe, but the passenger who turns the mechanism for the paddle, is seated like an ordinary rower, contrary to the arrangement which puts the passenger on a saddle just as if he were on a bicycle. The methods are of interesting application to those who cannot row and particularly to those who have lost the use of their arms. Just at present, a satisfactory solution has not been reached because it is believed that it is necessary to adopt the habitual position of the body of the bicycle rider.

This new little apparatus employs a train of gears fixed in the bottom of the canoe, which may be worked by pedals and this makes it easy to carry out, because it allows invalids to avail themselves of the service of the motor without the driver having any noticeable fatigue, even after very long trips. The form of the boat should be adopted to this style of pedal propulsion, and the apparatus can be coupled together, so that two motors work at the same time. In this case the two pedals are set at right angles to each other, so that there are no dead points in the movement, and a fly wheel will not be required. Otherwise, the dead point is not of particular influence, as long as the motor is in motion; even if there is only a single motor, this motor will transmit its movement to the screw. To go backward, it is necessary to pedal the reverse way. For fifty turns of the pedal, the gears give 750 turns to the screw. Taking in consideration the compactness of the pedal-motor, which is only 12" high, its slight weight, which is only 25 pounds, all can be easily placed in new and old boats.

To install the motor it is not necessary to put it exactly in line with the propeller shaft for a universal joint between the motor and screw is employed. This joint permits the motor to work with the greatest facility. The draft of the boat is not greatly increased on account of the slight weight of the mechanism, and it is possible to go about in the most shallow water.

The passenger who does his pedalling is in the most comfortable position using little effort with his legs for he is reclining as if in an arm chair. He steers the boat in the proper direction, and both hands are free so that it is possible to give himself up to additional occupations —reading, smoking or holding hands with his sweetheart. A motor of this kind can be adapted very nicely for small sailing canoes. Then of course when the wind fails, we have to use mechanical ways to return to our starting pier. Under these conditions our motor would be useful. There is no need of making the objection that the screw offers an extra resistance to the speed of the boat, because the wind being a force, it is evident that you can use all you want of it, to overcome this small amount of extra resistance. On the other hand, it is possible to arrange the screws so that for sailing their resistance will disappear and interesting models of these feathering propellers have been produced in several varieties. The use of the pedal motor on these little sailing canoes, will be therefore of great service to tourists, because it will permit them to break away from the necessity of having wind for continuing their trip. The fatigue which ensues upon the working of the pedals is much less in amount than with oars, which are often quite heavy. The action of the screw is much more efficacious for the same amount of power.

Denatured Alcohol Blamed for Deaths

Denatured grain alcohol rather than wood alcohol has been responsible for most of the illness and deaths from the alcohol poisoning reported lately is the opinion of an official of one of the largest American alcohol concerns. The country has been flooded with denatured alcohol, he said, and it has been freely distributed in bootleg circles.

He called attention to two formulas recognized by the Prohibition Commissioner and used in manufacturing toilet articles. Grain alcohol, treated in accordance with one of these formulas, is being widely distributed in five-gallon sample cans which can be purchased for experimental purposes without a permit, he says, and bootleggers are obtaining large numbers of these cans.

Bootleggers who have a knowledge of chemistry or who are associated with persons versed in chemistry recover the ethyl alcohol, it is stated, while the others, who are in the majority, simply color the stuff and sell it for whiskey. The authority said that the "whiskey" put out with simple coloring added is deadly and has caused most of the illness attributed to wood alcohol.

One of the formulas provided for combining 100 gallons of pure ethyl alcohol, and ten gallons of acetone. The other combines 100 gallons of pure ethyl alcohol, one gallon of isopropyl alcohol and sixty ounces of either U. S. P. alkaloids or salts, quinine bisulphate, quinine hydrocloride, cinchonidine or chinchonidine sulphate.

The acetone, it was stated, lacerates the stomach and the isopropyl alcohol paralyzes the nervous centres. Antidotes for wood alcohol poisoning do not combat either one of these chemicals, he added. In the majority of cases the attending physicians do not know that acetone and isopropyl alcohol have been taken into the system and therefore do not give the proper treatment.

Scientific Problems and Puzzles

By ERNEST K. CHAPIN

NO. 1 OF A SERIES

THE MECHANIC'S PULLEY SYSTEM

A MECHANICAL genius, the other day, said that he was tired of the old-fashioned block and falls and that he believed he could rig up a system that would beat the ordinary kind all hollow. After due deliberation, he set up his scheme as shown in Fig. 1 and offered to bet that there wasn't a man in the shop that could tell what weight, attached to the lower pulley, would be balanced by a downward force of 100 pounds applied to the rope A. Would you take up his bet and what would be your answer?

THE FLOATING CAKE OF ICE

Little Jimmy, while "sperimentin'" one day, brought in a cake of ice and floated it in a pan full of water. His mother was dismayed for she declared that as the ice melted, the pan was bound to run over and sop everything on the table. Jimmy, however, was sure it wouldn't, for, as he said, "the ice gets smaller and smaller as it melts, doesn't it, mama?" Well who was right, and how would the level of the water in the pan behave? (See Fig. 2).

THE FLOATING BALL TRICK

A magician on the stage took a light ball in his hands. "You will observe," he said, dropping the ball on the floor, "that this ball will fall of its own weight. However, if I charm it a little with a stream of compressed air directed *over* the ball, we see at once that the little sphere no longer obeys Newton's law of gravitation but spins unsupported in the air, clinging quite closely all the while to the invisible stream of air from the nozzle. And now will some scientific member of the audience kindly step forward and offer us an explanation of this phenomenon?" (See Fig. 3).

THE MYSTERIOUS BOAT

Cut a piece of cardboard, about an inch long, into the form of a little boat (Fig. 4). Into a notch in the stern of the boat fit a fresh crumb of gum camphor and float the boat in a pan of clean water. How do you account for the motion of the boat? Would a battleship move under the same power?

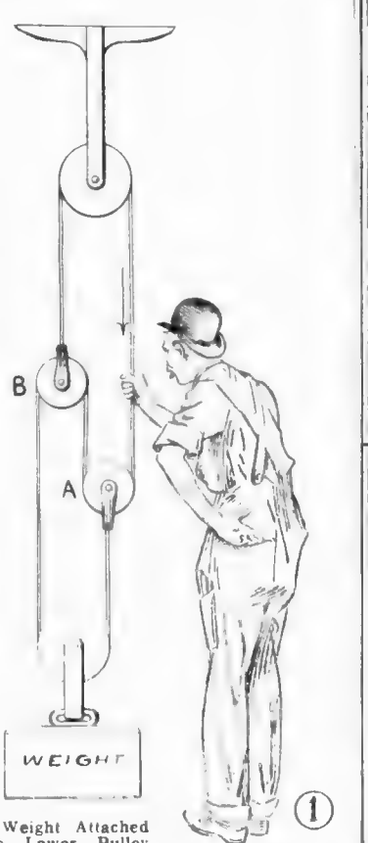
THE BAROMETER TUBE

A boy had a piece of glass tubing which he intended to use in making a mercurial barometer. On examining it carefully, however, he discovered that the tube was not of uniform bore. Would his barometer be inaccurate on this account?

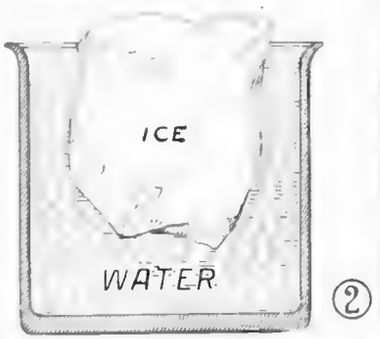
HOW MUCH ICE WOULD BE MELTED BY THE SLIDE?

A lad weighing 150 pounds ran at the rate of 20 feet per second toward a level sheet of ice and slid until he was stopped by the friction of the ice against his shoes. Now if the ice was at zero degrees Centigrade, and if we may assume that all of the friction was effective in melting ice, how much ice would be melted by his slide? (See Fig. 5).

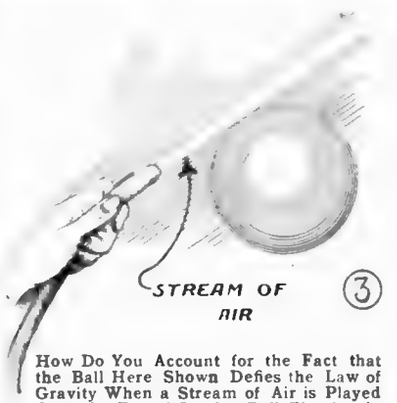
(*For answers to these Problems, see page* 484)



What Weight Attached to the Lower Pulley Would be Balanced by a Downward Force of 100 Pounds Applied to the Rope A?

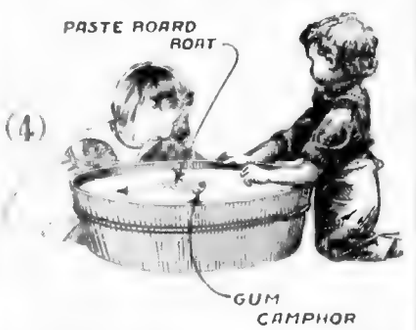


When the Cake of Ice Placed in the Pail of Water Melts, Will the Water Spill Over the Side of the Pail or Not?



How Do You Account for the Fact that the Ball Here Shown Defies the Law of Gravity When a Stream of Air is Played Over the Top of It, the Ball Floating in the Air as Shown?

A Paste-Board Boat With a Piece of Gum Camphor Attached to the Rear Will Spin Around Merrily in the Tub of Water. How Do You Account for This Phenomenon?



How Much Ice Would be Melted by the Friction Between the Slider's Shoes and the Ice?

Scientists May Baffle Disease

A solution of one of the questions which has baffled the medical science for years may be found as the result of discoveries made by Dr. Leonard Ely and his associates in the Stanford University Medical School.

The findings of Dr. Ely indicate that the same amoebae which cause dysentery are also responsible for a chronic type of joint inflammation known as arthritis deformans. While the report is a preliminary one, further studies are being made to confirm what may prove to be not only one of the striking recent medical discoveries, but also one that offers a probability of providing a satisfactory treatment for patients suffering from this disease.

Heretofore this type of ailment has been considered practically incurable.

If their discoveries are substantiated, several known methods of destroying the amoeba histolytica when it has invaded the body are now known to science.

Scientists have been working for many years on the subject of arthritis, practically in its relationship to diseases of the teeth and the tonsils.

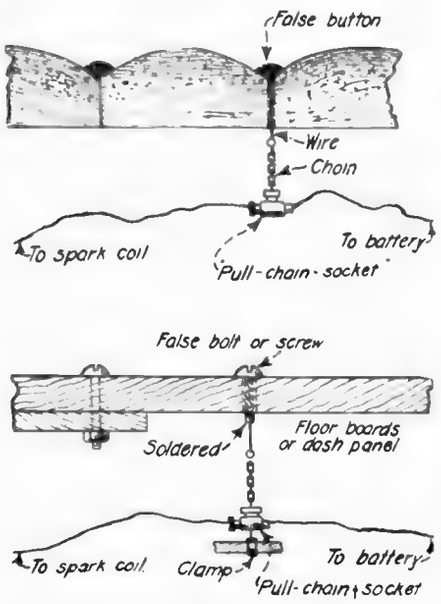
Final scientific proof of the discovery can come now only through animal experimentation, but it is probable that the immediate attention of the medical profession and of research workers in general will be attracted to this field so that more evidence will rapidly accumulate.

MOTOR HINTS

First Prize $25.00

SECRET SWITCH FROM PULL SOCKET

The secret switch shown in the accompanying illustration is so simple that anyone can attach one to their car. There are so many convenient places to attach the switch (pull chain socket) to, that no two people are likely to have their switches in the same place. The pull chain socket is clamped to



A Chain Pull Socket Makes a Good Secret Switch For Protecting Autos against Theft, When Hidden And Operated in Some Such Manner As Here Shown.

any convenient place under the car, in back or under the seat, or behind the dash panel. The pull chain leads to a false button in the seat cushion, or perhaps to a false screw or bolt in the floor or dash panel. By giving said false button or screw one pull, it will make connection between battery and spark coil; a second pull breaks it; a third connects, etc., etc.

It is easily and cheaply made, simply manipulated and can be well hidden.

Contributed by ADOLPH F. LONK.

Second Prize $15.00

A MOTOR SHOPPING REMINDER

Did you ever go shopping in the car and come home without the articles that you needed most?

A sheet metal box is made, and a clamp arranged, so that it may be fastened to the steering column. As shown in the illustration, a roll of memorandum paper is mounted on brackets in one end of the box, and a slot is cut in the top of the box, through which the paper may be pulled out as needed.

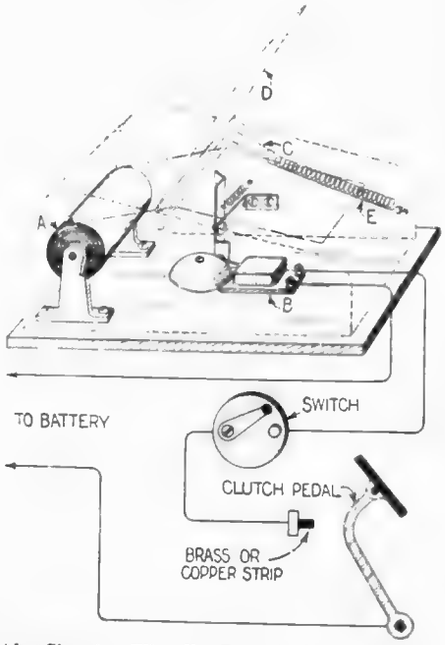
An electric door bell is mounted on the bottom of the box, and a small arm cut from sheet metal of the shape shown, is mounted directly to one side of the bell clapper. A hinged cover for the memo. paper is now arranged with an arm bent at an angle to it, which is inserted through a slot in the top of the box. This is hinged so as to allow it to swing freely, and a spring is attached as shown. A small spring is also attached to the pivoted arm inside the box. The bell is connected in series with a switch and the clutch pedal as shown.

When installed, the apparatus works as follows: Before you leave home, write your list of the things required on the paper, then close the cover and proceed.

When you stop in front of a store, and before you get out, close the switch. Now, when you come back to the car, you start the motor, and as you step on the clutch, the bell inside the box rings, the clapper swings the pivoted arm out, disengaging it from the cover arm, and the cover flies up. The bell ringing calls your attention to the memorandum, which is now exposed to view, and you are able to see at a glance whether or not you have everything that you intended to purchase. If so, turn the switch off, and the bell stops ringing. The cover can now be pressed back into place.

Contributed by JOHN E. BOSTOW.

[Ed. Note. Suppose a policeman thinks that the bell ringing is a "Stop Thief Alarm". What then?]



After Shopping, When You Press the Clutch Pedal, the Bell Rings and the Memo Pad is Exposed to View, Thus Aiding Your Memory.

$50.00 IN CASH!!

KINDLY note a change in this contest. For the coming months we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term **PRACTICAL** will be the keynote of this contest.

You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

FIRST	PRIZE.....	$25.00
SECOND	PRIZE.....	15.00
THIRD	PRIZE.. .	10.00

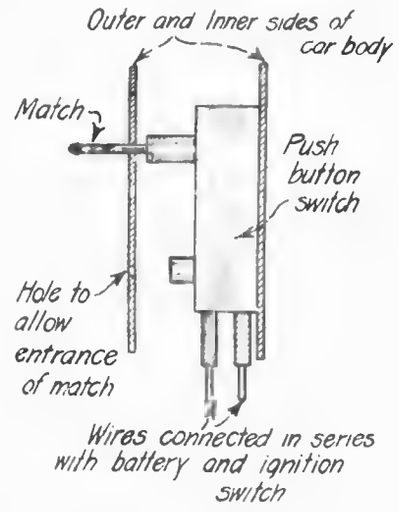
All other accepted articles which win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.

Third Prize $10.00

SECRET PUSH BUTTON SWITCH

In the illustration herewith is shown a switch system whereby one will never be troubled with faulty connections, as is often the result with home-made switch devices. Fasten an ordinary push button switch between the outer and inner sides of the car


Outer and Inner sides of car body
Match
Push button switch
Hole to allow entrance of match
Wires connected in series with battery and ignition switch

A Push Button Switch Placed Behind Dash, to be Operated by Match or Nail Through Hole is a Good Trick.

body, and connect this in series with the battery and ignition switch. Drill two holes thru the sheet iron side of the car, opposite the two push buttons. These should be just large enough to admit a match or nail, with which the circuit can be made or broken.

Contributed by JONAS BYBERG.

VARIOUS AUTO THIEF-PROOFING HINTS

Thief-proofing the auto can be done in a variety of ways. The best way, however, is to use a lock. If this does not appeal to the owner, there are other ways to prevent the operation of the car. One of them is to use a two candle power bulb set in a lamp socket in the instrument board, and connected to the primary ignition circuit, in such a way that when the bulb is removed the current is shut off. When the owner leaves the car, he drops the bulb in his pocket. This idea has a variety of modifications. A fuse might be used instead of a bulb, or a hidden switch located under the cushion, cowl, or back of the instrument board. If the carburetor has a spring controlled air valve, drill a tiny hole thru the valve guide and valve stem; so that when a pin is passed thru the valve, it is held open or closed, and the motor receives an improper mixture. A padlocked damper on the intake or exhaust pipe can be used effectively. The best place for it is on the intake pipe. Short-circuiting the safety spark plug gap is effective with tinfoil or fine wire. As the ignition is shut off by grounding the primary circuit, an effective way is to ground the primary wire at some place easy to reach, but hard to see. If the cables leading to the spark plug are about the same length, they can be exchanged so that no spark occurs at the same time. A three-way valve can be used to shut off the gas and drain the carburetor at one turn of a rod extending from the dash.

Contributed by ORVAL HARDEN.

We Herewith Announce One of the Most Interesting Prize Contests That We Have ever Conducted, We Believe. $50.00 in Prizes is Offered for the Three Best Ideas in a Combination Device, for Practical Everyday Use, Such as Those Here Illustrated. The Devices Shown Above, and Which are Available on the Market, Comprise a Pen-Pencil-and-Eraser; a Perpetual Calendar Mounted in the Cap of a Fountain Pen; a Combined Cane-Umbrella; a Lady's Hand Mirror With Self-Contained Flashlight and Battery; a Revolver Flashlight, Capable of High Accuracy in Night Shooting; Safety Guard for Ordinary Razors; Combination Tooth Brush and Tooth Paste Dispenser; an Electric Curling Iron and Comb Combined; an Electric Cigar Lighter and Flashlight or Trouble Lamp for Automobiles; and Finally a New Automobile Novelty in the Form of a Combined Parking Light and Mirror.

"Combination" Prize Contest

ONE of the most interesting thoughts we had the other day while passing through a New York shop was the realization that many geniuses apparently have not awakened to the fact that there are innumerable opportunities for making money by combining in a certain novelty two or more ordinary everyday things, such for example, as a *pen-pencil-and-eraser*. This well-known utility can be purchased in practically any stationery store at prices ranging from 15 cents upward, and thousands of school children buy them every year. One of the simplest combinations of two distinct and valuable utilities is perhaps a pencil with an eraser attached on the end. Looks simple, doesn't it, but it took a little hard thinking to bring about this happy union between two otherwise separate and distinct necessities.

A few months ago, we published in the columns of this journal, a description of an interesting invention recently placed on the market—a *calendar fountain pen*. This is shown in the accompanying illustration, and it should meet with undivided favor among all business and professional people, for if there is any one thing that a person either hates or neglects to carry, it is a calendar, and many valuable opportunities are frequently lost through not having a calendar at one's finger tips, so to speak. A calendar

Combine two or more everyday things and win a prize

pen is a welcome addition to the accessories of business and professional life

The combination *cane-umbrella* shown in one of the accompanying pictures, is, or rather should be, a much desired novelty, but for one reason or another, this is not as popularly used as many other combination appliances to be found in shops. The first of this combination so far as the writer is aware, was made in France, and first saw the light of day on Broadway, New York, about twelve or fifteen years ago, but at least one American manufacturer is supplying the American market with a very good improved model of such a collapsible umbrella. Many a gentleman for one reason or another, would like to carry a cane, but while out walking, he might be caught in a sudden shower, and so perforce the distinct utility of such a combination of two different articles becomes patent

Then we have another meritorious novelty in the *mirror-flashlight*, which may prove extremely useful in milady's boudoir, but particularly when she's traveling; and the men folks find it very useful in shaving, especially when camping or traveling. Mr. H. Gernsback has a patent on this combination mirror-flashlight. The battery is cleverly concealed in the hollow handle of the mirror. A push button for lighting the lamp is contained in the handle also, and the wires from the battery to the flashlight bulb, which is mounted flush with the mirror surface, pass under the glass inside the wooden frame, entirely concealed.

Did you ever try to hit a bullseye with a combination *revolver-flashlight?* If you have not, you have one of the greatest surprises in store that you ever experienced. A fountain-pen type flashlight attached to to the barrel of a revolver or automatic pistol, should prove very useful for policemen and other law enforcement officers, and it is surprising how accurately one can shoot with this combination of a flashlight and pistol. One simply pushes the flashlight

(*Continued on page* 499)

$50.00 IN PRIZES

For the three best ideas for a combination device made of two or more ordinary every-day things like those illustrated above, we are offering $50.00 in prizes, as follows:

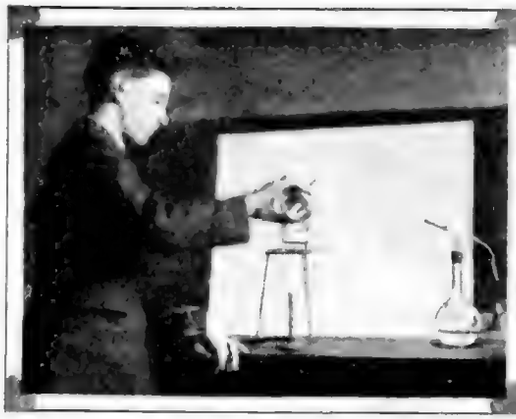
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

This contest closes October 15th, at midnight, and full details concerning the contest are given in the accompanying article. Address all contributions to—Editor of "Combination Prize Contest", care of this publication.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

QUALITATIVE ANALYSIS—FIFTH PAPER



Dissolving an Alloy in Nitric Acid Preparatory to the Determination of Its Constituents.

Dissolving the Precipitates of Calcium and Barium Carbonates by Pouring Acetic Acid thru the Filter Containing Them.

Making the Test for Ammonia by Holding Moist Red Litmus Paper in the Escaping Vapors.

IN this article we shall complete the analytical procedure for the groups of the metallic elements. Following this we shall take up the tests for the various acid radicals, and then be ready for the systematic examination of an unknown substance.

Ammonium Carbonate Group. In this group only two metals are included. They are calcium and barium. Prepare a mixture of small quantities of rather strong solutions of calcium and barium chlorides. Add a few cc. each of ammonium chloride and ammonium hydroxide. Then add a solution of ammonium carbonate and warm the mixture. The white precipitate that forms consists of calcium and barium carbonates. Filter and wash the precipitate. When subsequent groups must be considered the filtrate should be tested for complete precipitation by adding a little more of the group reagent, ammonium carbonate. In addition, the last traces of calcium and barium must be removed by adding to the filtrate a few drops each of ammonium sulphate and ammonium oxalate solutions. This will precipitate any barium as the sulphate of that element and any calcium as oxalate. To insure complete precipitation warm the filtrate and allow it to stand for a short time.

The main precipitate of calcium and barium carbonates should be dissolved by pouring through the filter containing them about 1 cc. of acetic acid. Repeat the process until solution is complete.

Barium. To the filtrate add a few drops of a solution of potassium chromate. A yellow precipitate of barium chromate will form, thus proving the presence of this metal. Filter, obtaining a clear yellow filtrate, which will contain calcium.

Calcium. Make the above filtrate alkaline with the addition of ammonium hydroxide, and then add ammonium carbonate solution. A white precipitate of calcium carbonate will form, proving the presence of this metal. If in the course of regular analysis no precipitation should occur at this point, add a few drops of a solution of ammonium oxalate warm, and allow to stand for a time. The appearance of a white precipitate of calcium oxalate proves the presence of small quantities of calcium. Ammonium oxalate is a more delicate reagent for this metal than ammonium carbonate.

When too much acetic acid has been added the barium will not all precipitate as chromate in the preceding procedure. In that case a precipitate of barium chromate will form in testing for calcium simply upon the addition of the ammonium hydroxide and before the ammonium carbonate has been added. In that case filter off this yellow precipitate of barium chromate before adding the carbonate solution.

Soluble Group. In this group occur the remaining metals, whose compounds are mostly soluble, together with the ammonium radical, which acts like a metal. These are magnesium, sodium, potassium and ammonium.

Prepare a mixture of the chlorides of these elements. To a small portion of this mixture add a little each of ammonium chloride and ammonium hydroxide and then a little of a solution of di-sodium hydrogen phosphate. Shake the test tube vigorously and rub its sides with a glass rod. A white crystalline precipitate of magnesium ammonium phosphate will form. In order to obtain this test readily the solution must be concentrated.

Sodium. If magnesium is present, as it is in this case, it must be gotten rid of before sodium and potassium can be tested for. To do this add a solution of barium hydroxide until an alkaline reaction occurs. Then filter and remove the barium, which the filtrate contains, by precipitation with ammonium carbonate solution. Warm and filter into a porcelain dish. Then evaporate to dryness and heat the dish over the Bunsen flame until it becomes a dull red in color. Shift the dish so that every part of it is evenly heated. This heating will decompose and drive off the ammonium compounds present, but not those of sodium and potassium.

When the evaporating dish is cold dissolve the residue in a few drops of water and make the flame tests for sodium and potassium. Clean your platinum wire by dipping it in concentrated hydrochloric acid and heating it in the oxidizing flame of the Bunsen burner until it no longer colors the flame. Then dip the cleaned wire into the solution and again hold in the oxidizing flame. If sodium is present a very bright yellow flame will be obtained. If the flame is not brilliantly yellow, the color is probably due to some accidental impurity in the reagents used.

Potassium. Potassium gives a violet to lavendar-colored flame, but in the presence of sodium it will always be masked by the yellow sodium flame. In order to exclude the sodium flame and see the violet potassium, observe the flame through two or three thicknesses of cobalt-blue glass. If much potassium is present, the color will at once be apparent.

To be certain of potassium, however, add a few drops of a solution of chloro-platinic acid and evaporate to dryness on a water-bath. Upon treating the residue with a little water and alcohol a heavy yellow highly crystalline precipitate will be seen.

Ammonium Compounds. Since ammonium compounds have been used throughout the analysis of the preceding groups as reagents, and also because in the preceding group it has been necessary to drive them off, it is obvious that the ammonium radical must be tested for in the original solution.

This is accomplished by *warming*, not boiling, a small portion of the original mixture with either sodium or potassium hydroxides and holding in the vapor a moist piece of red litmus paper. If ammonium compounds are present the escaping ammonia gas will, of course, turn the litmus paper blue.

Systematic Analysis for the Metals. Before proceeding with the analysis of acid radicals it will be essential to any adequate

October Feature Articles

New Animated Picture Display for Show Windows.

Pilotless Planes Deliver Mail. By H Winfield Secor.

Airplane Writes Words in Smoke—the Latest Scientific Advertising Stunt.

The Super-Regenerative Audion Circuit. By Robert E. Lacault.

Animal Monsters in Miniature. By Dr. Ernest Bade.

Poisonous Snakes, Snake Poisons, and Their Antidotes. Written by an Expert.

Detecting the Criminal Mind by Scientific Instruments. Exclusive Photos and Tests by Staff Medical Expert.

Unusual Sources of Motion. By E. R. Caley.

Popular Astronomy—A Remarkable Double Star System. By Isabel M. Lewis, M. A., of the U. S. Naval Observatory.

mastery of the preceding work to start with a mixture containing some metals from each group and separate and identify them. It will also add to the interest if you will have some friend prepare a number of unknown mixtures for you to analyze.

In all such work the utmost care must be exercised. Beakers, test tubes and every piece of apparatus must be perfectly clean. If possible, distilled water should be used. A chemist never uses anything but distilled water in all qualitative work. In precipitating the metals of each group complete precipitation must be had each time. Whether or not this has been accomplished can be told by adding more of the group reagent to the group filtrate. The filtrate from each group must be preserved with great care, for it, of course, contains all of the metals of the succeeding groups. Usually the washings should be added to the filtrate. If the resulting volume is large it may be concentrated by evaporation.

Step by step you will eliminate the various metals and be able to say with certainty just which ones are present and which are absent. Frequently the addition of a certain reagent without the formation of a precipitation will eliminate a whole group of metals. Qualitative analysis calls for keen observation at every point. A poor observer may miss some metals altogether, as well as make unnecessary work for himself.

Analysis of an Alloy. Excellent practice in the analysis of the metals may be had by the systematic determination of the metals present in some alloy. Obtain a small piece of an alloy, preferably one the constituents of which you do not know. Then proceed as follows:

Try first to dissolve it in fairly strong nitric acid. To assist in the solution, boil. If the alloy dissolves completely gold, platinum, tin and antimony are known to be absent. In that case dilute the solution and proceed with the regular analysis for the metals of the various groups, beginning with Group I.

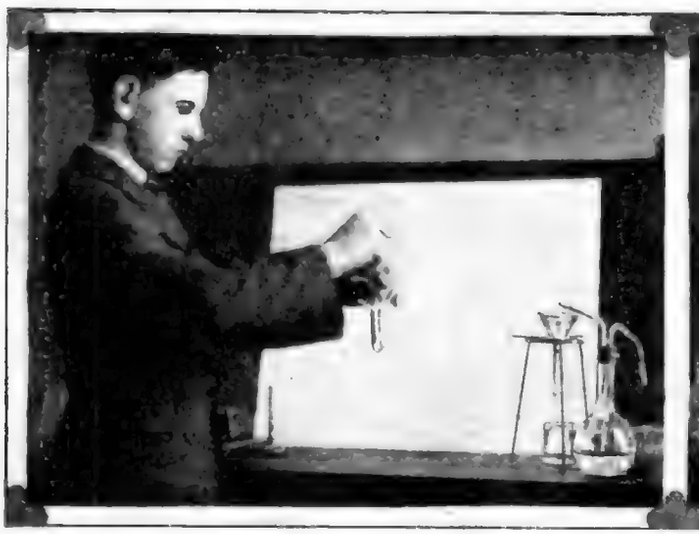
If a metallic residue is left gold and platinum may be present. Dissolve in aqua regia and proceed as already described under Sub-Group B of Group II.

If a white residue remains after dissolving in nitric acid it may consist of insoluble compounds of antimony and tin or of certain metallic nitrates which are not easily soluble. To dissolve any nitrates that may be present add water and warm. Then filter and test the filtrate by the regular qualitative process, beginning with Group I.

To determine whether antimony may be present, wash the residue on the filter thoroughly and place a portion of it in a porcelain dish. Add dilute hydrochloric acid and then a small platinum foil with a bit of metallic zinc upon it. As already described, if antimony is present the simple couple that is set up will generate nascent hydrogen, which will reduce the antimony compound to metallic form, leaving a black stain on the foil.

To test for tin boil the other portion of the residue with concentrated hydrochloric acid and add an iron nail. This reduces the tin compound, if present, to stannous form. Upon the addition of a solution of mercuric chloride, a white precipitate of mercurous chloride will be obtained if tin is present. This is open to criticism, as it is an indirect test only.

We have now completed the systematic analysis of the metals of the various groups and shall be ready in the next article for the analysis of the acids. For it must be remembered that unless it is a metal, a metallic oxide or a base, an unknown substance will be presumed to contain an acid radical. We are, of course, not considering here organic compounds.



Rubbing the Side of the Test Tube with a Glass Rod in Making the Test for Magnesium.

Making the Flame Test for Sodium by Holding a Platinum Wire Dipped Into the Solution, in the Oxidizing Flame of the Bunsen Burner.

Where Do All the Rubber Tires Go?

By JAY G. HOBSON

ACCORDING to the information at hand there are over a million automobile tires manufactured each working day. That means a million rubber tires worn out, navigating rough roads that increase friction and wear, and 90 per cent. of this costly destruction could be eliminated by improved streets and country roads.

It is a singular fact that most country roads are kept in better repair than the streets and roads within lesser distance of the cities. In 50 Indiana and Ohio towns that I recently motored through not one had as good streets and urban roads as the state highways. The mystery of it all lies in the truth that the city officials have the time and the help to keep their streets and nearby roads at least as passable as the country roads, but for some unexplained reason most city roads are so bumpy and rough that the visiting motorist receives a jolty impression that is anything but favorable to the town through which he passes and probably patronizes.

The feeling that I had when experiencing the uninviting approaches of the various towns through which I passed was one of disgust and impatience with each place so careless as to neglect the most important item in their community's growth, *i. e.*, a smooth approach and well-kept streets to guide the visitors within reach, and when departing to assure words of pleasure to others bound for the same place. A good first impression goes a long way, and this holds true even with auto-tourists who are becoming more numerous each year.

Therefore, in view of the choppy roads over which rubber tires must carry the sailors of the gasoline boats it is little wonder that so many rubber factories manage to earn such handsome dividends by supplying the public with rubber air containers for their auto wheels. Some day when the cities wake up and improve their streets, tires will last longer and the rubber factories won't have the monopoly they have now. An automobile without pneumatic tires would be like a monkey without a tail, it could get around all right, but the getting would never be the same. That's the reason we have never had a successful substitute for the rubber tire.

THE CONSTRUCTOR

Magic With a Conical Mirror

By JUAN CAMPS CAMPINS

THESE rather odd pictures become common objects when viewed from over the apex of a conical mirror, placed in the circle in the center of the object. We would suggest to the reader that he enlarge the pictures with an ordinary camera or make the enlargements by means of a pantagraph. As a matter of fact, enlargements are not absolutely necessary; the mirror could be made small enough to be mounted in the circle shown in the diagrams here. As shown in Fig. 1, the picture is viewed from above. The additions on the outer circle are only intended to be puzzling, but they do not really come into the picture, being merely added to complicate the diagram. The reason these do not appear is that in the reflection they fall too far inside—too near the apex of the cone. In the first diagram the method of making these drawings is illustrated by the tracing of the main rays of incidence and reflection. If diagram 2 is properly enlarged, a nickel shaving stick case placed in the circle, and the scene viewed from the side, the brachycephalic monster shown becomes a baby sucking on a bottle, as illustrated in the small circular insert found in the same diagram. This same feature holds true in the other diagrams, where the circular insert indicates in each the appearance of the grotesque object as viewed through a mirror of the conical type. In Fig. 2 only a shaving stick case is to be employed.

Fig. 2. A Most Surprising Freak Among Optical Experiments is the One Here Illustrated. All You Need in Order to Perform This Trick of Optics, is a Nickel-Plated Shaving Stick Can, or a Piece of Nickel-Plated Pipe, or Even a Piece of Tin Bent Into a Tube, Which is Placed on the Circle Mark, and When You Look at the Side of the Tube, You Will See the Perfect Picture Shown in the Lower Circle.

The mirror can be made out of sheet tin which should possess a high metallic luster. This tin is cut in the form of a sector of a circle, and then the radial edges of the sector are soldered together, being permitted to overlap each other slightly. Several experiments will show the required height of the cone. It will be found that the diameter should in general be equal to the height of the reflector, and that the diameter will depend upon the size of the enlargement of the pictures, equal to that of the circle. Another method of making the mirror would be to employ brass or copper shims. These shims can be easily bent and soldered, after which they should be dipped in hydrochloric acid and mercury rubbed upon their surface until coated, thus producing quite a brilliant mirror.

The editor of this publication discovered in the course of some of his experiments that ordinary zinc amalgam, when placed in a bag or sack of chamois and rubbed on bristol board, produced a very beautiful mirror. The method of making the amalgam is to take

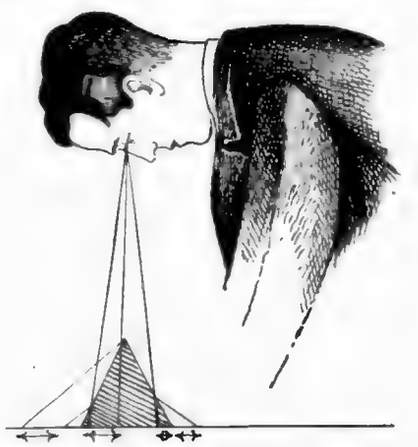
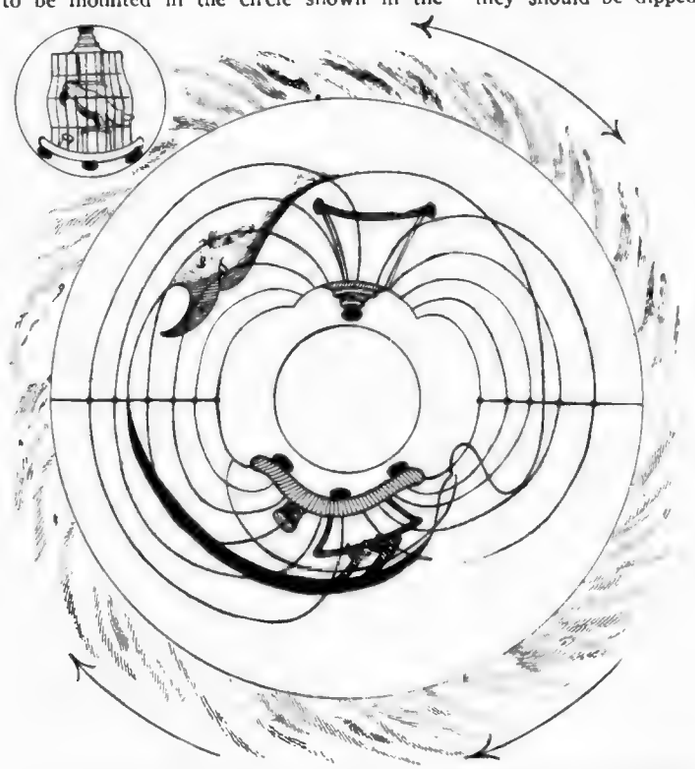
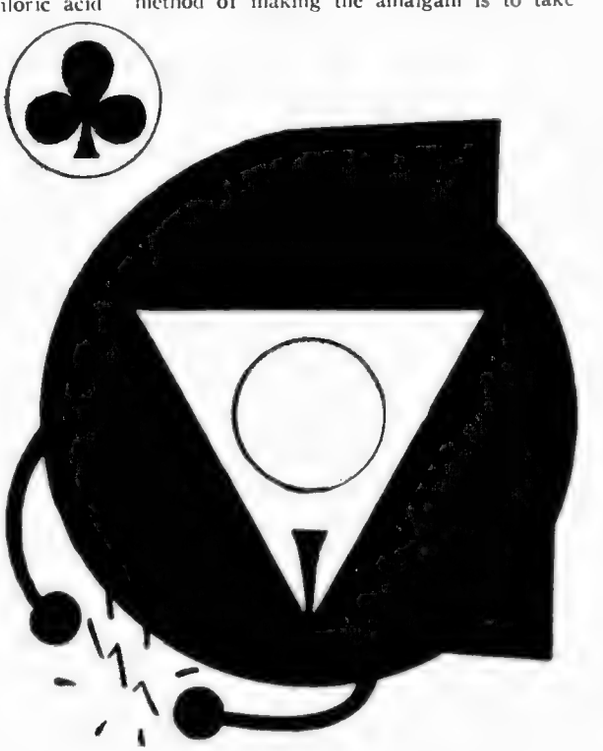


Fig. 1. Why One Sees a Perfect Image When Looking Down on a Conical Mirror, Placed Over One of the Grotesque Drawings Shown Elsewhere on This and the Following Page, is Made Evident From the Diagram Given Above. The Conical Mirror Acts as a Concentrator or Center of Focus for the Freak Drawing Placed Under it. The Mirror May be Made From a Piece of Tin or Aluminum Bent Into a Cone.

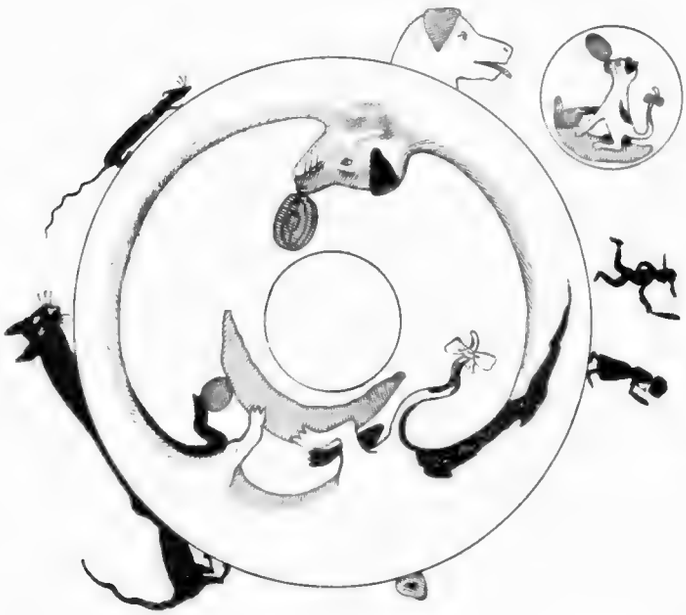


Look First at the Large Drawing Above—You Would Scarcely Believe That This Drawing Would Resolve Itself Into the Perfect One Shown in the Small Circle, Would You? A Conical Mirror Placed In the Center Circle Will Surprise You.

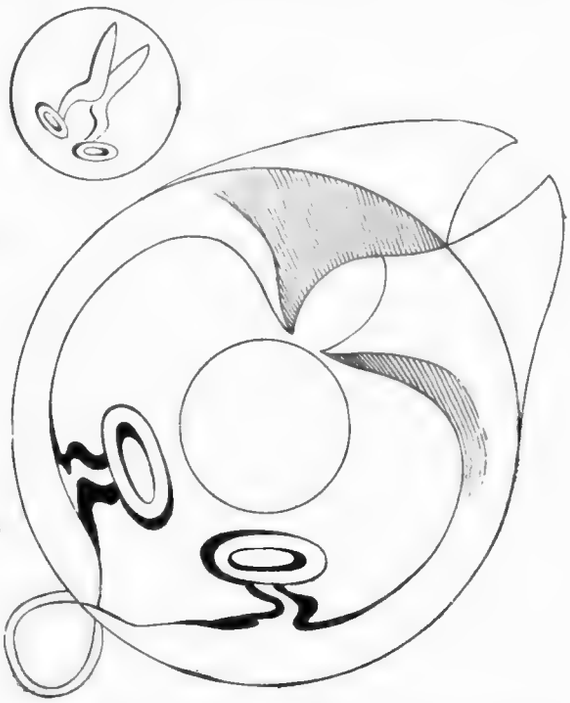


When the Conical Mirror is Placed in the Center Circle of the Diagram Above, and One Looks Down Upon it From a Height of a Foot or so, the Oddly-Shaped Black Figure Resolves Itself Into a Shamrock.

pure zinc and add mercury thereto until there is an excess of mercury. In other words, sufficient mercury is added so that when the amalgam is pressed, a few globules of mercury will drop out of the mass. If this amalgam is then placed in the chamois sack, and pressure applied thereto while the bristol board is rubbed, an almost perfect mirror is obtained, which can be twisted, turned or bent into any conceivable or desirable shape. This idea is particularly adaptable to this experiment because of the fact that it is inexpensive, and enables the experimenter to construct the mirrors for the designs here shown, without a soldering iron, the ordinary paste pot being employed instead. After viewing these distorted objects, the experimenter will find it rather simple to make other drawings similar in effect, yet more grotesque.



When the Conical Aluminum Mirror is Placed in the Center Circle of This Drawing, the Confused Looking Two-Headed Dog Changes into a Single Dog, Balancing a Ball on His Nose.



The Odd Shaped Drawing Shown Herewith, by the Aid of a Conical Mirror, Changes into a Pair of Shears. Many Other Grotesque Figures Can be Drawn for Use with the Conical Mirror.

Useful Articles From Tin Cans

Empty tin cans are worth keeping. A great many useful odds and ends can be made from them, in addition to their use for storing small articles. For example, half a pound coffee can, divided longitudinally and fixed upright at one end of a wooden base, forms a good reflector to increase the light of a candle. The candlestick is simply placed upon the wooden base.

The use of a round tobacco tin can, with a loose lid for holding a ball of string, is by no means new. An improvement can be effected by making the hole through the middle of the lid a little larger than usual so that an ordinary boot eyelet can be fixed in it. There will then be no risk of fraying the twine; in fact, the tin would answer equally well for holding a ball of darning wool. A further improvement may be effected by soldering part of an old penknife blade to the edge of the lid for cutting off lengths of twine as required. A razor blade may be recommended for this purpose.

Funnels for culinary purposes can be made with the expenditure of a little more trouble. Probably the simplest way is to make a paper funnel first, to get a pattern, afterward cutting a sheet of tin from a biscuit box to form the conical part, and soldering the edges together after double reaming as neatly as possible. The top edge should be turned in for safety. The narrow tube at the apex of the cone must be made separately and fixed after the cone is finished.

Contributed by

H. J. GRAY.

Merry-Go-Round

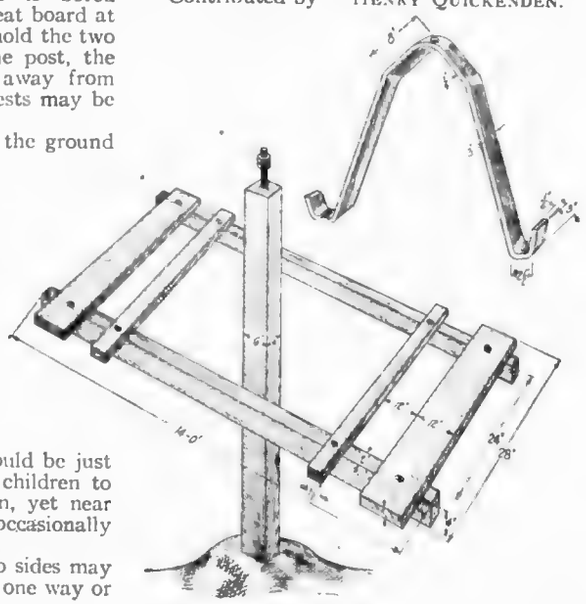
A home-made Merry-Go-Round for the enjoyment of the children may be made at an expense of not more than four dollars. Secure a discarded wagon tire or a piece of strap iron, about three inches wide, one-fourth inch thick and five feet long. Have a blacksmith bend it, as shown in the picture, nearly in the shape of a V, with the ends turned up so as to hold the 2″ x 4″ scantlings, the apex being spread enough to clear the 6″ x 6″ post, which acts as the support. A half-inch bolt is to be sunk into the top of the post with a nut made fast three inches from the top on which the apex of the V revolves with but little friction. A washer on top the nut will further reduce the friction. A half-inch hole is bored through the V at the apex. A seat board at either end of the scantlings will hold the two firmly as they revolve about the post, the scantlings being nearly a foot away from either side of the post. Hand rests may be added if desired.

The post should be sunk into the ground enough to make it rigid, and should be just high enough for the feet of the children to clear the ground when in motion, yet near enough to permit them to touch occasionally to impart motion to the machine.

Difference in weight of the two sides may be adjusted by sliding the beams one way or the other through the supporting V. The photograph shows this inexpensive contrivance actually constructed.

Contributed by HENRY QUICKENDEN.

The Cheapest Merry-Go-Round is Here Shown in Actual Operation, the Two Little Girls Having Stopped for a Moment to be Photographed. Details for Building this Extremely Simple Carousel Are Given in the Accompanying Drawing.



Probably the Simplest and Cheapest Merry-Go-Round for the Youngsters One Can Imagine, is That Here Illustrated. The Principal Dimensions Are Given in the Drawing, the Wooden Seat Frame Being Supported on the U-shaped Iron Member Illustrated.

How I Built a Small Speed Camera

By FRANK M. BLACKWELL

IN the course of a number of years spent in the gathering of events for the various motion picture news reels I often felt the need of a small *still* camera with a fast lens and shutter which could be readily operated with one hand while the other was occupied with the making of the motion picture.

Not being able to buy a camera which filled the desired requirements, I built the one which is herewith illustrated.

With the exception of the lens, the necessary parts and materials can be found in and about the average shop, or can be purchased at small cost

I found a lens of 75 mm. focal length, working at a speed of F. 3.5, to be the most advantageous. Negatives of extreme sharpness and definition can readily be obtained even when working in poorly lighted places. These negatives will readily stand enlarging up to prints of 8 by 10 inches in size.

To readers who are interested, the photographs, with their accompanying legends, will tell the complete story. No measurements can be given as they would, naturally, vary according to the focal length of the lens used by the builder.

Fig 1. Shows the camera as it looked when completed and ready for operation. "1" indicates the focusing dial which is joined to the focusing mount of the lens. This dial is scaled and when revolved until the proper number comes into view on the outside of the camera brings the lens into correct focus. "8" indicates the fastening of the door which is opened for loading the camera.

Fig 2. Shows the camera with the door ("2" of Fig. 1) opened. "3" is a felt washer which makes the camera absolutely light-proof. "4" is an inside wall which covers the mechanism of the camera and also acts as a bearing for the ends of the curtain rollers "9" and "13". "5" is the cavity which receives the unexposed roll of film. "6" is the empty spool and the cavity which takes up the film as it is exposed. "7" is the ruby window through which the numerals on the roll of film are viewed. "8" is the lock which holds the door tightly closed after the camera is loaded.

Fig. 3. Shows the camera with the door ("2" of Fig. 1) and the inside wall ("4" of Fig. 2) both removed so as to show the mechanism. "9" is the rewinding roller for the curtain shutter. "10" is the roll of unexposed film threaded through the camera and on to the take-up spool "6". "11" is one of the openings in the curtain shutter. "12" is the aperture through which the exposure is made. "13" is the spring containing roller which pulls the curtain shutter downward past the lens when the release "14" is pressed. "15" shows the gearing which opens the safety door "16" simultaneously with the releasing of the shutter. "17" is the lens. "1" is the focusing disc attached to the lens.

Fig 4. "9" is the re-wind roller for the shutter showing how it is slotted to receive the end of the curtain shutter. "18" is the shutter made of opaque rubberized cloth. "11" indicates two of the different sized openings in the shutter. "20" is the lower end of the curtain which slips into the slot "21" of the take-up roller "13". The shaft of the roller "13" revolves freely inside the roller. One end of a coil spring inside this roller is attached to the shaft. The other end is attached to the roller itself. This is an exact duplicate, in minature, of the ordinary window-blind roller. It is the tendency of this spring to uncoil which draws the opening rapidly past the lens when the release ("14" of Fig. 3) is pressed downward. Thus the exposure is made.

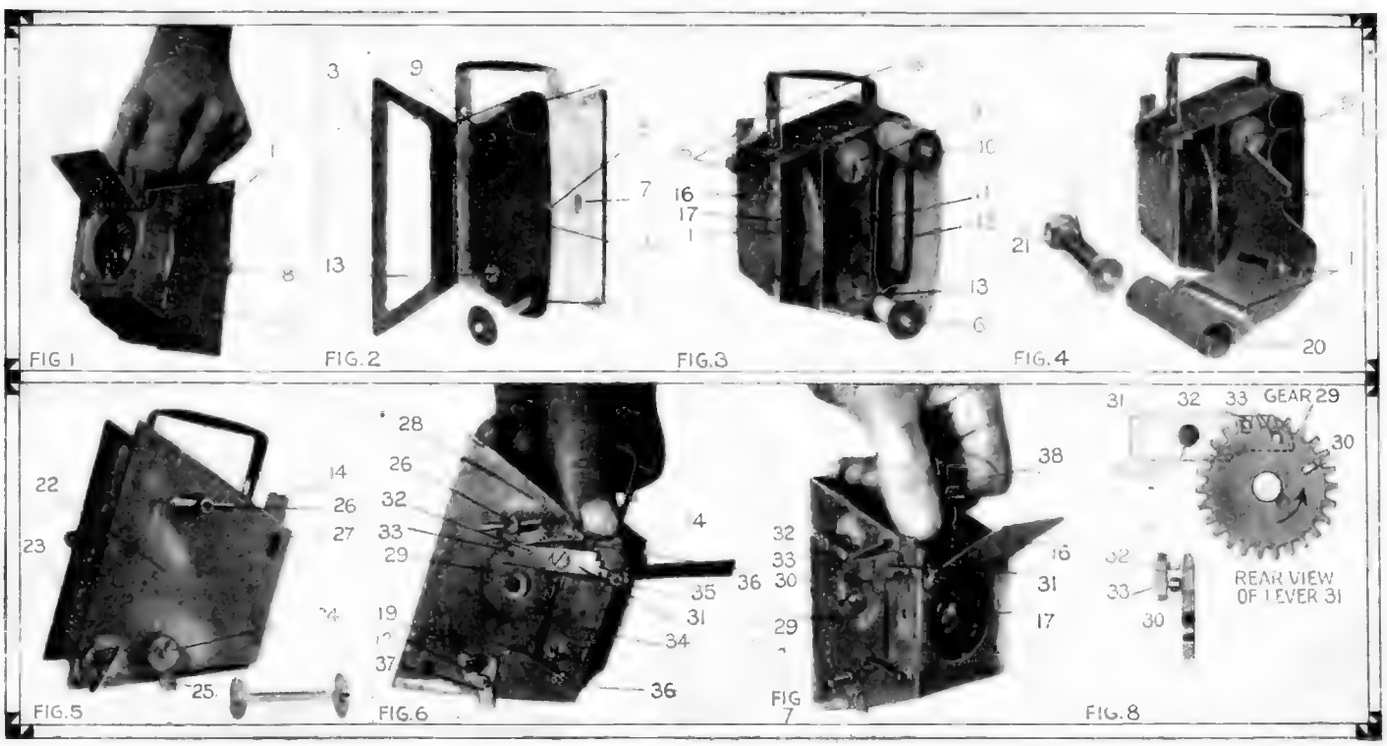
Fig. 5. Shows the right-hand side of the camera. "22" is a shell of light metal which covers the camera gearing. "23" is a knob for winding the film into the lower receptacle after the exposure is made. "24" is a knob on the end of the shaft in the lower curtain roller. By revolving this knob more tension is placed on the curtain spring—thus making the shutter travel faster and giving a faster, or shorter, exposure on the film. "25" is a ratchet for releasing this tension. "26" is a knob with which the curtain is reset. The arrow on this knob points to the different figures on the side of the camera—thus indicating the opening in the curtain which will pass the lens. "14" is the shutter release. "27" is also a shutter release. The arrow on the knob "24" indicates the various tensions placed on the curtain spring. This may be increased or lessened at the will of the operator in keeping with the exposure which he desires.

Fig. 6. Shows the camera with the cover ("22" of Fig. 5) removed so as to show the gearing and shutter release mechanism. "28" is a gear fastened solidly on the end of the shaft of the re-wind roller. The teeth of this gear mesh with those of the gear "29" which carries a lug ("30" of Fig. 7). The bar "31" carries two lugs, "32" and "33", one slightly above the other.

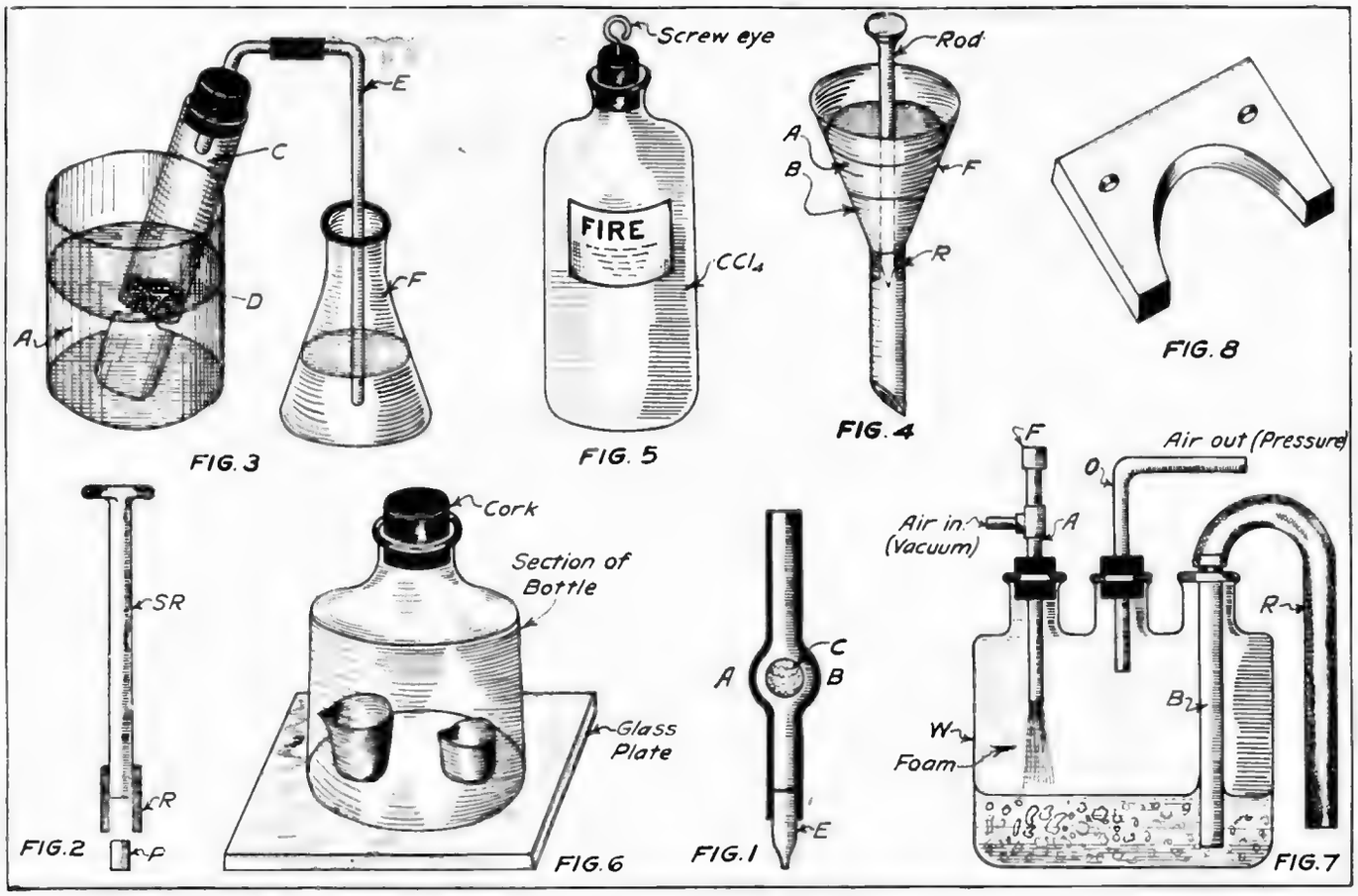
The action is as follows:

Pressure at "14" moves the bar "34" downward, carrying the forward end of the bar "31" with it. This lifts the lugs "32" and

(*Continued on page* 501)



The Cost of Building This Small "Speed Camera" is Slight Outside of the Lens, Which Should be of the Anastigmat Variety, Having a Focal Length of 3 Inches and a Working Aperture of F 3.5. With the Average Size Lens Corresponding to These Specifications, Pictures Up to 3 ¼x4 ¼ Inches Can be Taken, But it is Preferable to Use Somewhat Smaller Film, and Build the Camera Accordingly. A Focal Plane or Curtain Shutter Is Used, the Same as in the Graflex and Other High Speed Cameras. The Distance of the Image From the Camera is Judged as Cosely as Possible and the Camera Focused for This Distance by Turning the Graduated Dial on the Lens, Which Moves the Lens Back and Forth to the Proper Distance From the Film. These Focusing Lens Mounts are Available on the Regular Market.



Simple Laboratory Apparatus.—1, A Simple Pinchcock; 2, the Flexible "Policeman" Used to Detach Precipitates From the Insides of Beakers; 3, A Gas Generator on the Fashion of the Kipp Type; 4, A Funnel, Piece of Rubber Tubing and a Glass Rod Make a Handy Separatory Funnel; 5, A Carbon Tetrachloride Fire Extinguisher is Useful in the Experimental Laboratory; 6, Dessicators Are Used to Dry Precipitates, etc., an Inexpensive Form is Shown Here; 7, A Combined Vacuum and Air Blast Apparatus; 8, the Semi-Circle of Wood Keeps the Mortar Steady While Grinding.

Simple Laboratory Apparatus

By RAYMOND B. WAILES

QUITE a number of pieces of laboratory apparatus can be made from small parts and pieces, and their operation competes well with professional types and styles.

Simple Pinchcock.—Fig. 1 shows the cross section of a simple pinchcock. It consists of a rubber tube containing a ball of glass or a ball bearing. The ball should be large enough to cause stoppage of the rubber tube, but when its sides A, B are pinched a small opening is formed which allows the liquid or air to flow through the tube. A glass marble serves best for the ball

Policeman.—This piece of apparatus is a combined stirring rod and instrument to rub off precipitates from the sides of beakers. See Fig. 2. It is made from glass rod, 8 inches long with a 1-inch length of rubber tubing (R) on one end, and projecting over it as shown. A small plug of rubber (P), such as is formed when rubber stoppers are bored with cork borers, should be inserted in the overhanging end as shown, thus making a flexible end. The other end of the rod may be flattened by softening in a Bunsen flame and pressing on a block of asbestos.

Gas Generator.—A lamp chimney and a battery jar make a serviceable gas generator, as Fig. 3 shows. The constricted part of the lamp chimney should contain a lead disc, drilled with several holes. If the end E is allowed to dip into a solution to be precipitated of H_2S metals, and the lamp chimney placed in 1:4 HCl (commercial), the acid will rise into the chamber of the chimney and act on lumps of ferrous sulphide placed therein, and prevented from falling out of the chamber of the chimney by the perforated lead disc D. As soon as the gas is under good pressure, the pressure backs the acid out of the chamber into the battery jar, so the action is automatic.

Carbon dioxide can be made from acid and a carbonate (preferably marble); hydrogen from acid and zinc; sulphur dioxide from acid and a sulphite, etc.

Separatory Funnel.—If a piece of rubber tubing is forced into the upper part of a funnel as Fig. 4 indicates, and a glass rod drawn to a point is thrust into the tube, liquids placed in the funnel cannot flow out through the stem. On removing the rod the liquid will flow out. Oil from water, ether extractions, etc., from aqueous layers can be separated by this means. If layer A is an ether layer and B a water layer, they can be separated by lifting the rod until the water layer is drawn off, and the instant the ether layer is ready to escape the rod is to be pushed in.

Fire Extinguisher.—A narrow oil bottle filled with carbon tetrachloride (Carbona) and suspended by a screw eye makes a serviceable extinguisher (Fig. 5). If the bottle is hung by the screw eye a strong jerk on the bottom of the bottle will cause the cork to be pulled out and the contents will be ready for instant use. It should hang on the shop or laboratory wall.

Simple Dessicator.—This useful instrument is made from a cut off bottle, as shown, ground smooth on its bottom edge on a glass plate, which should be about ¼ inch thick. Carborundum valve-grinding paste or simple beach sand and water should be used in grinding the bottle edge smooth. By putting the bottle with the abrasive on the glass and pushing the bottle section across the same, the glass and the bottle both become ground together. After a more or less prolonged working, a little vaseline smeared in a circle where the edge of the bottle rests upon the ground glass base will make a perfect fitting joint. A small beaker filled with calcium chloride should always be kept under the cover or bottle section. This serves to remove the water from the chamber in which crucibles containing ignitions, etc., are placed, as shown.

Vacuum-Blast Apparatus.—Using a three-necked Wolff bottle, a continued vacuum and blast (air) apparatus, suitable for filtering, for glass working, for brazing, etc., can be easily made. In Fig. 7, A is a simple aspirator pump, metal or glass. Water enters F from faucet. Air is sucked in as indicated and the resulting foam is impinged on the bottom of the bottle, causing the air to separate and leave the whole by means of the exit tube O, thus producing air under pressure. The water injected into the bottle is led out through the *large diameter* tube B, which is connected to the drain pipe or sink by rubber tube R. The end of R should be much lower than the bottle W.

Mortar and Pestle Kink.—A semi-circle of wood cut as shown in Fig. 8 will serve to hold a mortar while grinding is being done. It should be fastened to the table by means of wooden plugs, making it capable of instant removal.

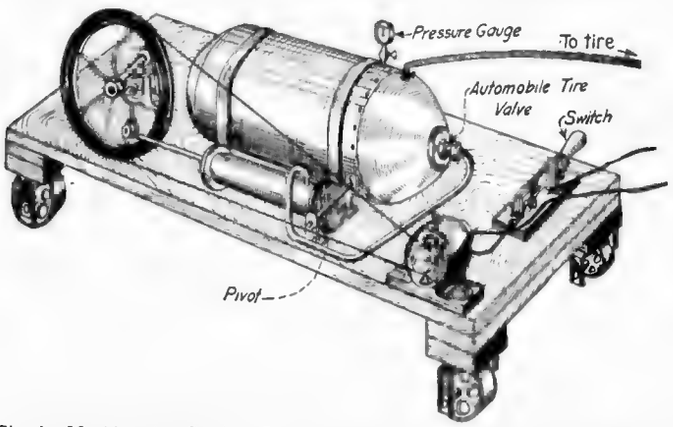
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $15.00

SERVICE AIR SUPPLY FOR GARAGE

Air compressors for the home garage are seldom found. The owners of automobiles think more of the exercise in pumping up their tires by hand than building a small air compressor. The construction of such a device is, however, very simple. An ordinary water tank or Presto-Light tank of large size is strapped to a board mounted upon roller casters in any approved manner. A pressure gauge is preferably mounted in the side of the tank and an automobile tire valve is inserted where the outlet of the Presto tank usually lies. A large sized bicycle pump is then obtained and two pipe straps are attached to its base, which hold an iron pipe rigidly in place. This pipe swings in two "L" shaped straps secured to the board, as shown in the illustration herewith.



Simple Machine for Storing Compressed Air for Private Garages. The Whole Outfit is Mounted on Wheels, and May Be Pulled Anywhere Desired. The Small Electric Motor Drives a Large Bicycle Pump, Rigged Up with a Tank and Pressure Gauge in the Manner Illustrated.

The handle of the pump is removed and the rod itself bent so that it may be fastened to an eccentrically mounted pivot on the wheel of an old sewing machine. If desired, this pump rod could be attached to the crank shaft of the driving wheel of such a sewing machine and the wheel and bent shaft could be employed.

The wheel is freely mounted on a piece of pipe securely fixed in two pipe brackets. A small eight-horsepower motor is secured to the board and connected by a belt to the larger pulley. It will therefore be seen that when the current to the motor is turned on the pump acts as an air compressor. Its pivoting permits of the use of a straight piston rod instead of the usual hinged type.

If in operation for a few moments the tank gauge will register 80 or 100 pounds pressure. If this pressure is maintained, the exact pressure in the tire is instantly determined without the necessity of testing with the tire valve, as the valve on the pressure tank indicates the maximum pressure in the circuit.

The device is portable and light, making it easily movable. Air pressure supplied by the same could be used by an artist for air brush work or on farms for actuating sprays and whitewashing stalls.

Contributed by J. K.

SECOND PRIZE, $10.00

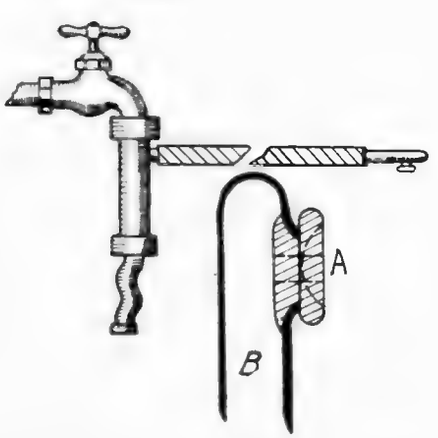
A VACUUM TOOTH CLEANER

No matter how thoroughly or how often the teeth are cleaned with a brush, decaying matter is always left between the teeth and in the little recesses. This fact can be demonstrated by running a thread between the teeth after they have been cleaned with both brush and mouth-wash.

With but little trouble or expense an apparatus was devised which would quickly remove this offending material. And, after observing the amount of material removed, one feels that the mouth must be clean, and that the time and money expended in making the apparatus was well spent.

This consists mainly of either a Chapman, Richard, or Sprengel form of vacuum pump, which can be easily attached to any ordinary faucet. A surprising amount of suction is created by the force of water running through this little pump, which is provided with proper check-valves. Next, a 5-inch glass tube is required. The end is sealed and a hole is blown at the side near the end. A glass-blower, chemist or apothecary can do this job in five minutes. Into the orifice at the side of the tube "B," as shown in the cut, fit a rubber seat, "A," which can be whittled from a solid piece of rubber. Bore a hole through the rubber, as indicated by the dotted lines, and make the outer surface slightly concave or cup-shape. After connecting the cleaning instrument with the vacuum pump by means of a thick-walled rubber tube of any required length, the apparatus is complete and ready for use.

Contributed by
R. C. Holmes and O. K. Hopkins.

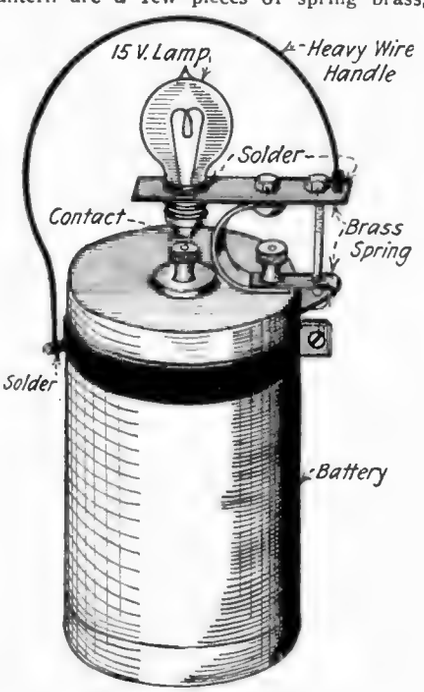


A Vacuum Tooth Cleaner is Easily Constructed From a Test Tube B, Having a Hole Blown in the Side at A, the Vacuum Being Produced by Any Standard Form of Spigot Aspirator.

THIRD PRIZE, $5.00

AUTOMATIC ELECTRIC LANTERN

The materials required for making this lantern are a few pieces of spring brass, some heavy wire, a 1.5 volt lamp and one dry cell. The feature of the electric lantern is that it automatically lights when lifted and goes out when set down, unless the thumbscrew is adjusted to secure steady light. One side of the handle is soldered to a metal clamp fastened about one inch below the top of the battery, and the other is soldered to a strip of sheet brass ½ inch wide and 2¾ inches long. A 1.5 volt lamp is soldered in a hole in the other end of the strip, so that the contact of the lamp is ½ inch below the strip.



When You Pick the Lantern Up by the Handle the Base of the Lamp is Pressed into Contact with the Center Terminal of the Dry Cell, and the Lamp Lighted.

A piece of spring brass ½ inch wide is bent as shown, and is screwed under the negative binding post and fastened to the brass strip which carries the lamp.

As long as the lantern is carried by the handle it remains lit, but goes out when put down, which prevents it from burning when not in use, thus prolonging the life of the battery.

Contributed by G. McGregor.

TO MAKE A HOLE IN GLASS

Holes may be made in ordinary glass without much difficulty. When the spot where the hole is desired has been decided upon, encircle the place with moist clay. The center should be quite free from the clay, and it must be exactly the size of the hole required. Support the glass over the ground or above a floor where there is no risk of fire, and pour molten lead into the aperture. The glass and the lead will instantly fall to the ground, leaving behind a cleanly cut hole.

Contributed by W. R. Reinicke.

Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

Firework Making for Amateurs

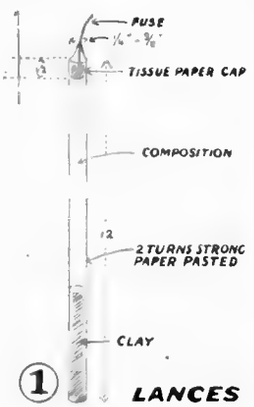
By RAYMOND B. WAILES

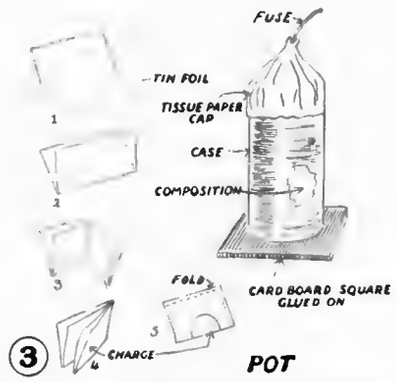
MEMBER AMERICAN CHEMICAL SOCIETY

THE art of pyrotechny is a trifle more advanced a science than the simple mixing of various ingredients to make the pleasing devices known to so many.

Many calculations are necessary in the perfection of such devices, for instance, rockets. Simple weighing and mixing, can, however, result in many pleasing pieces of firework, as this article shows.

Colored fires are in the main made of combustible materials, such as sulphur or charcoal, mixed with saltpetre (potassium nitrate), potassium chlorate, etc., often with some alkaline earth nitrate, as barium, or strontium nitrate, to impart a characteristic color to the flame. Several good compositions are given herewith.





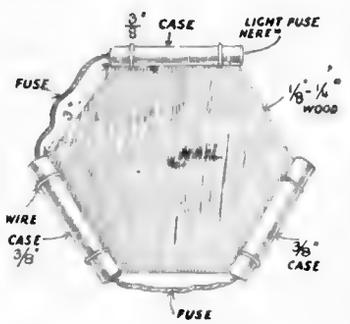
1—Lances Are Very Simple to Make. Slugs of Vari-Colored Fires Can Be Used if Desired.

2—Stars of Roman Candles Are Compressed Light-Composition Tablets, Molded With Paste. Use a Heavy Case.

3—Caps Can Be Rolled From Tinfoil. Pots Should Have Heavy Cases of Fire Resistant Paper; Otherwise the Burning Paper Would Give a Yellow Flame and Mask the Original.

4—A Perchlorate-Aluminum Powder Noise-Maker. Absence of Heavy Paper Slugs Makes it Less Harmless Than Cannon Crackers.

5—Catherine (Pin) Wheels Always Command Attention. They Should Be Filled With Meal Powder.



RED FIRES

1. Strontium nitrate	16	parts
Sulphur	4.5	parts
Potassium chlorate	4	parts
Lampblack	1	part
2. Strontium nitrate	9	parts
Powdered shellac	3	parts
Potassium chlorate	1.5	parts
Charcoal	4	parts
3. Strontium nitrate	8	parts
White sugar	4	parts
Potassium chlorate	1	part

The above ingredients in formula 3 are soluble in water and the solution can be soaked up into bibulous paper and the paper dried.

GREEN FIRES

1. Barium nitrate	30	parts
Potassium chlorate	9	parts
Sulphur	11	parts
2. Barium nitrate	18	parts
Sulphur	6	parts
Potassium chlorate	4	parts
Lampblack	1	part
3. Barium chlorate	90	parts
Orange shellac	10	parts

BLUE FIRES

1. Potassium chlorate	12	parts
Sulphur	2	parts
Copper sulphate	1.5	parts
2. Potassium chlorate	8	parts
Sulphur	3	parts
Ammonium-copper sulphate	2	parts

WHITE FIRES (BENGAL LIGHTS)

1. Barium nitrate	75.5	parts
Aluminum (flake)	21.8	parts
Sulphur	2.7	parts
2. Potassium nitrate	7	parts
Sulphur	2	parts
Antimony	1	part
3. Potassium nitrate	12	parts
Sulphur	3.5	parts
Charcoal	.5	part

All parts are by weight. Each ingredient must be powdered *separately* before the whole is mixed. Never grind two substances in a mortar at the same time.

LANCES, TORCHES

These are illustrated in figure 1 and consist of a paper case (not heavy) enclosing the light-producing composition. A wad of clay serves to close the end used as a handle. A short piece of fuse made as below thrust into the composition and the end capped with tissue paper, using a bit of paste, seals the ignition end.

ROMAN CANDLES

These devices are made of a heavier stock of paper then Lances, so that, when the composition burns, the walls are not consumed. Figure 2 shows how a simple Roman candle is made. Ordinary gunpowder or meal powder can be used with some success for the expelling charge which is placed under each star. Stars are made by using a lighting composition moistened with a gum solution made of 1 drop of mucilage in 20 drops of water, molding to size and then air drying.

FUSE, MATCH

Quick fuse can be made by using a 1:20 part mucilage solution with gunpowder and rubbing the paste on *soft cotton* string and allowing to dry. Quick match can be made by soaking the string, untreated in a potassium nitrate solution.

CAPS

Detonating caps are composed of the following ingredients, in the proportions indicated. The antimony sulphide caps will detonate with a slight blow.

1. Potassium chlorate	6	parts
Antimony sulphide (black)	6	parts
Sulphur	½	part

Powdered black antimony sulphide should be used. A roughened wire imbedded in this mixture contained in copper tubing is used to fire salute cannon by the pulling out of the roughened wire.

2. Potassium chlorate	1	part
Sulphur	1	part

Either of the above compositions can be made into caps by enclosing a bit within tobacco foil, as shown in figure 3.

SNAKES, PHARAOH'S SERPENTS

1. Solutions of sodium (or potassium) sulphocyanate and mercurous nitrate, when mixed, produce a precipitate of mercurous sulphocyanate. This white precipitate, when dried, can be mixed with a bit of dextrose and water and molded into cones. The ingredients, as well as vapors arising from combustion, are poisonous.

2. Potassium dichromate	2	parts
White sugar	3	parts
Potassium nitrate	1	part

The above composition, *when moistened*, dried and molded, forms a harmless snake in the grass when ignited.

SPARKLERS

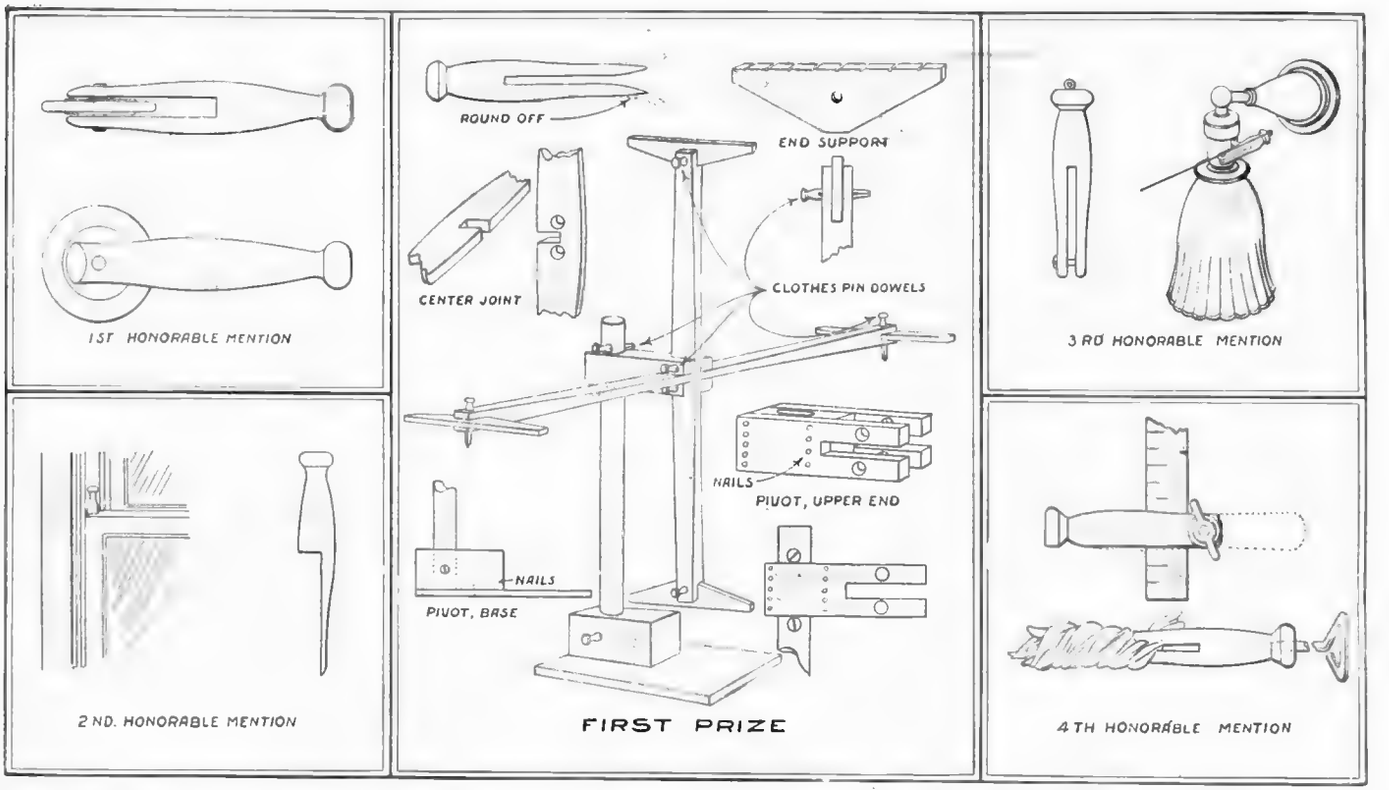
Iron wires coated with any of the following compositions are called sparklers. The sparkling effect is due to the burning of the iron or aluminum filings or powder contained in them.

1. Barium nitrate	4	parts
Iron filings	2	parts
Aluminum powder	1	part
Potassium nitrate	1	part
Paste (flour)	2	parts
2. Sulphur	3	parts
Potassium chlorate	5	parts
Shellac	1	part
Mercurous chloride	2	parts
Magnesium powder	2	parts
Aluminum powder	2	parts
Copper oxychloride	2	parts

SMOKE COMPOSITIONS

Several of these smoke compositions were

(*Continued on page 482*)



Useful Things Made by the Aid of Wooden Clothes-Pins. First Prize Idea—Collapsible Loop Aerial Frame, Pinned Together with Dowels Made from Wooden Clothes-Pins in the Manner Shown. First Honorable Mention—Handle for Rubber Eraser; Second Honorable Mention—Wedge to Lock Window and Prevent Rattle; Third Honorable Mention—Clamp to be Attached to Key of Electric Light Socket Together with Cord, in Order to Enable Person in Bed to Turn Lamp On and Off; Fourth Honorable Mention—Depth Gauge and Test Tube Cleaner Made from Wooden Clothes-Pins.

"Clothes-Pin" Contest Awards

WINNER OF $5.00 PRIZE

CLOTHES-PINS AS DOWELS IN LOOP AERIAL

Clothes-pins are made of hard wood and in consequence of this the prongs are strongly elastic. These qualities caused one radio builder to adopt them as dowel pins in the construction of an indoor loop aerial. The loop aerial frame made was large and to avoid interference with available space, the several parts are disassembled by simply pulling out these dowels. The details of this aerial and the location of the clothes-pin dowels are depicted in the sketch. The end of each pin was trimmed down for ease in entering the dowel hole. For similar wood work, the clothes-pin as a dowel is an advantageous adaptation, inasmuch as it is readily inserted or removed and quantities of these are usually available.

Contributed by G. A. Luers.

FIRST HONORABLE MENTION

CLOTHES-PIN ERASER

Here the clothes-pin is arranged to be used as an eraser. It eliminates cramps which naturally come when there is quite a lot of erasing to be done. The clothes-pin overcomes this as the head of the same fits in the palm of the hand and all the pressure comes from the hand instead of the fingers.

I have used this every day for the past fifteen years and feel that I could not be without one. The eraser used is a No. 493 Eagle disk eraser. A small hole is drilled and a match is stuck through the same and broken off which allows the eraser to revolve.

Contributed by Max J. Neumayer.

SECOND HONORABLE MENTION

CLOTHES-PIN ANTI-RATTLER

By breaking one leg from the ordinary clothes-pin a most efficient anti-rattler for windows may be made. The top prevents the pin from working downward, while the tapering leg easily fits almost any crevice usually found in rattling windows, and locks it at the same time.

Contributed by Herbert C. McKay.

THIRD HONORABLE MENTION

ELECTRIC LIGHT ATTACHMENT

Here is a simple attachment for an electric light socket which will allow a person in bed to turn the light on and off without getting up. Pulling the string turns it on; pulling it farther turns it off—then the lever has to be reset. A clothes-pin with a small screw-eye in its head and a screw through the forked end, which is cut off, makes the lever. The other end of string is tied to head of the bed.

No Name.

FOURTH HONORABLE MENTION

DEPTH GAUGE AND TEST TUBE CLEANER

My first idea is for a depth gauge made of a steel or boxwood scale, a clothes-pin, washers, bolt and wing nut. The clothes-pin is planed flat on one side and cut as illustrated.

The second idea is for a test tube cleaner made of a clothes-pin, a piece of ⅛-inch rod and a cloth. A hole is drilled in the head of the pin into which the rod is forced, forming a handle. The cloth is wrapped on the clothes-pin as shown in the illustration.

Contributed by Philippe A. Judd.

A Physico-Chemical Shimmy

It is a well-known fact that the surface tension of mercury causes it to assume the form of an inverted U when contained in a glass tube or other receptacle. It is not so well known, however, that the mercury flattens out when covered with a dilute sulphuric acid solution. These phenomena lead to an interesting and instructive little experiment.

A small globule of mercury, about one-half to one-quarter of an inch across, is placed in a small evaporating dish or saucer. The mercury is then covered with sulphuric acid solution, 1 to 10, and a crystal of some catalytic agent, say potassium bichromate or cupric sulphate, is added. If we now touch the globule of mercury with a common iron nail, it will be seen to jump violently, even though it was but gently touched. The iron nail should now be placed in the solution in such a manner that the point is just making contact with the mercury; the mercury will then vibrate continually with rapid pulsations until the nail is dissolved by the acid. With careful adjustment the "shimmy" should last for several hours.

The accepted explanation for this phenomenon is an electrical one. It appears that the mercury loses some of its surface tension when covered by the acid because it received an electrical charge. The iron nail removes this charge, the mercury springs back, and the process is repeated. At first glance this looks like perpetual motion again, but a moment's consideration convinces us that the motion can no longer take place after the nail is dissolved. It is certain, however, that no inconsiderable amount of mechanical energy is released, and this suggests that it might be amusing to attempt to harness this power in some manner so that it might be utilized, say for running a clock.

Contributed by

James F. Zweighaft.

RADIO DEPARTMENT

Who Discovered Radio?

By A. P. PECK

MOST of our elementary text books on radio and the scientific books used in the schools, teach us that the basic phenomenon of electric wave transmission of energy through space was first demonstrated by Heinrich Hertz in 1888. These waves have become known as "Hertzian Waves."

However, upon investigation it is found that as early as 1871 experiments were conducted by Prof. E. J. Houston of the Central High School, Philadelphia, Pa., which showed that electrical energy could be induced through space without the aid of wires. The following is a description of how Prof. Houston happened to note this phenomenon.[1]

He was experimenting with a 6 inch Rumkorff induction coil, and endeavoring to increase the length of the spark produced by it. He placed a spark gap across the secondary of the coil, and connected one side of the same to a gas pipe running through the laboratory. The other side he connected to a long wire lying on the laboratory table. When the coil was put into operation, he found that the length of the spark had been diminished, but the thickness was increased, and the color changed to a silver white; in fact all the changes were practically the same as if a Leyden jar had been connected across the gap. While the current was on, sparks could be drawn from various metallic objects around the room, even though they were not connected to the ground. He tried the same experiment, using a stove in the laboratory in place of the long wire on the table and obtained the same results. He also found that while the coil was in operation he could draw sparks from another stove situated in the next room, and which could not have possibly been connected in any way to the induction coil.

In 1875 Thomas A. Edison, then of Newark, N. J., discovered what he called "Etheric Force." He had performed experiments with an electro-magnet and circuit-breaker, with a carbon rod detector such as is shown in the accompanying illustration, and he arrived at the conclusion that a new force was present which enabled the currents

Prof. Elihu Thomson, One of the First Scientists to Experiment With the Induction of Electrical Waves. His Experiments are Described at Length in This Article, and Were Quite Similar to Those Made by Hertz Who is Generally Credited With the Discovery of Radio, Although These Experiments by Prof. Thomson Were Made Twelve Years Before.

to be induced in other metallic objects not connected in any way with the source of current.

Houston, however, did not look upon Edison's so-called discovery with favor,[2] and in conjunction with Prof. Elihu Thomson, also of the Central High School, he repeated the work with the same results as before. These two scientists then performed a number of experiments, which showed that no new force had been discovered, because all the results obtained were consistent with the known laws of electrical science.

The results of the experiments were as follows:

No. 1. The gold leaves of a delicate electroscope did not diverge upon being brought into contact with metallic objects yielding the sparks, although in every case, sparks could be seen at the point of contact.

No. 2. The needle of a delicate astatic galvanometer was not sensibly deflected by the sparks on an apparent current being caused to traverse the coils of the instrument.

No. 3. A small shred of cotton wool was not sensibly attracted or repelled by objects from which the sparks might be obtained.

No. 4. The so-called "retro-action" of the spark was distinctly observed. On looping a wire back on itself, a decided spark was seen at the point of contact made by the end of the wire with any portion of the wire itself.

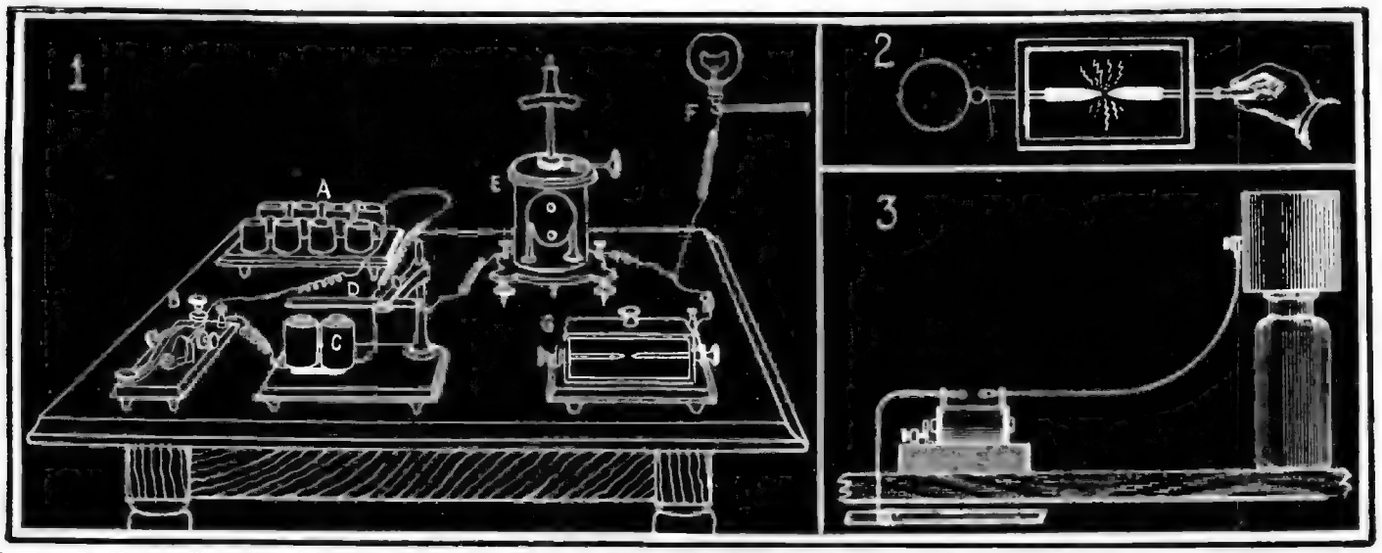
Houston decided that these results were due to induced electrical currents, without the intervention of any new force whatever.

In accordance with the experiments made by Edison, an electro-magnet with an interrupter in the circuit was tried, and was found to yield sparks from a wire attached to the core when the interrupter was in action. The keynote to this action is the rapid reversal of the current which is now known as the "high-frequency effect."

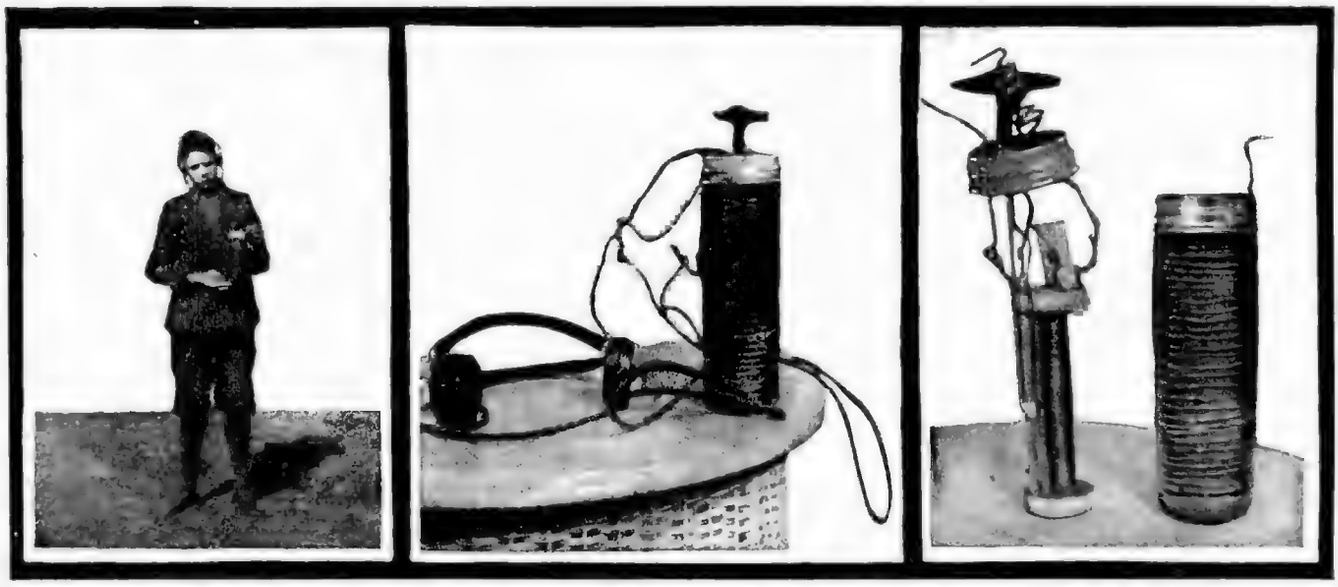
The sparks obtained in any of the above experiments, apparently had no polarity. This however, was explained in the following manner. The outgoing current being immediately followed by an incoming current, re-established the electrical equilibrium, and when we realize the frequency of change, we can understand why the polarity did not register on the galvanometer or electroscope, inasmuch as the polarity reversed many times in a second.

The following statement was made by Prof. Houston. "The presence of the inverse current immediately following the

(*Continued on page* 504)



In Fig. 1 We Have an Illustration of the Apparatus Used by Thomas A. Edison in His Early Experiments with "Etheric Force." "A" is a Battery; "B" is a Key or Circuit-Breaker; "C" a Pair of Electro-Magnets; "D" a Flexible Steel Bar or Vibrator; "E" an Astatic Galvanometer; "F" a Gas Pipe to Which a Wire is Grounded, and "G" a Carbon Rod Detector. In Fig. 2 is Shown a Clearer View of the Carbon Rod Detector Used by Thomson and Houston. A Brass Ball at the End of One of the Carbon Rods Served as an Antenna or Capacity. In Fig. 3 is Shown the Transmitting Apparatus Used by Thomson and Houston, Which Consisted of an Induction Coil and Gap, One Side of Which is Grounded and the Other Side of Which is Connected to a Tin Can Placed on a Glass Jar for Insulation.



Wireless in a Pickle Bottle—It's the Cat's Meow—Here's the Apparatus and it Works.

The Complete Pickle Bottle Radio Receiving Set with Phones and Aerial Wound Around Outside of the Bottle.

Pickle Bottle Radio Set Disassembled, Showing Tuning Coil and Detector.

Radio Outfit in Pickle Bottle

By EDGAR I. EISENSTADT

This *walking radio station* consists of a tuning coil and a galena detector. The bottle is 8½ inches high, with an inside diameter of 2⅛ inches.

The tuning coil comprises a section of broom handle about 5½ inches long, and is mounted between circular pieces of wood sawed to fit the inside of the bottle. On this core wind a layer of No. 18 D. S. C. wire, from which remove the insulation on a straight line about ⅜ inch wide. Tack both ends of the wire to the wooden core, leaving about 2 inches of the upper end free. Drill a ¼ inch hole in each of the wooden ends, into which is fitted a square wooden rod to serve as a slider rod. Before this rod is glued in place, make a slider of brass which will fit it This slider is ¼ inch wide, with a pointed extension to make contact with the bared wire. To the top of the slider, solder a knitting needle so that it will be parallel to the rod. Place the slider on the rod, and glue the rod securely into place. Cut a piece of copper, ¼ inch wide, and 1 inch long, pierce it in the center, slip it over the end of the knitting needle, and tack it to the end of the coil in such a way as to form a guide for the knitting needle and also make contact with it. To this piece of copper, solder two pieces of insulated wire, one 3 inches long, to connect to the aerial, and one 6 inches long, to connect to one terminal of the receiver. This needle is used to vary the inductance on the coil by moving the slider.

Next cut two pieces of copper ¾ inch square, and tack to opposite sides of the upper end of the coil. To one of them solder the wire from the end of the winding of the tuning coil, a piece of No. 20 piano wire, and a piece of insulated wire about 18 inches long, which is used to connect to the ground. From a piece of copper 1½ inches by ½ inch shape a bezel, and solder to the copper plate in such a way as to hold a piece of galena in place. To the piano wire solder a brass pin, so that it will be in position to make contact with the galena. To the last mentioned square of copper, solder a piece of insulated wire one foot long, which connects with the other terminal of the receivers.

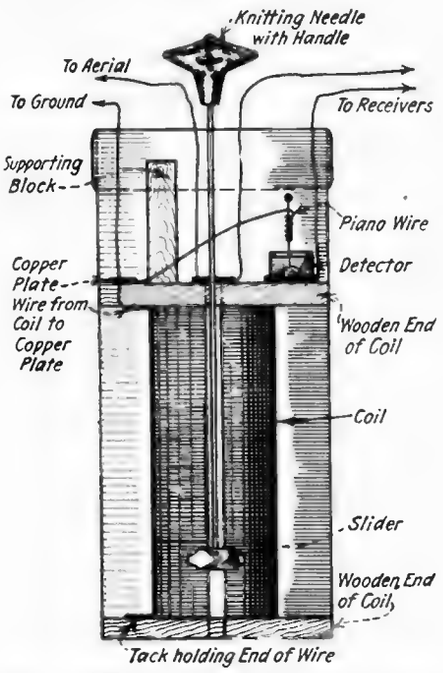


Diagram Showing How Detector, Tuning Coil, Slider, Etc., Are Arranged Inside of Pickle Bottle.

The outside of the bottle is painted with paraffin and covered with a layer of cotton wadding, over which is sewed a cover of silk Jersey. Over this wind a layer of No. 18 S. C. C. wire, which forms the aerial. Sew the lower end of this wire fast to the Jersey, and fasten the upper end in the same way, leaving about 1¾ inches of wire free, which is attached to the wire connecting to the slider.

In the cover of the bottle, pierce five holes in such a position, that the four wires and the needle may be passed out thru them. Cut a block of wood that may be wedged between the top of the coil and the cover, in order to hold the coil in place. To the top of the knitting needle, solder a piece of heavy wire at right angles to it. Cover this with insulating tape. This is to form a handle.

The ground connection is made by attaching two blocks of wood to each shoe. Drive some small nails thru each block, allowing them to protrude about ⅜ inch. Solder a wire to the nails on the front block, run it to the heel block, and solder to the nails in that, whence it is run up the side of one leg, to the waist where it connects with the wire from the other foot. They are soldered together, and the ground wire from the set attached to the joint. As one foot is always on the ground, you will have a constant ground connection, and will be able to receive radio messages while "on the go."

1922 Radio Sets to be Junk in 1932—Marconi

Radio science will have advanced to such an extent in the next ten years that the apparatus now in use will then be practically worthless, Guglielmo Marconi declared while on his recent visit to this country.

The inventor said that the Marconi wireless station at New Brunswick has been practically rebuilt three times at a cost of $3,000,000 within the last ten years. Mr. Marconi is at present paying more attention to experiments with short radio waves than the longer ones. He said this had been found more adapted in transmitting code messages than the human voice across short distances on land or between ships close together at sea.

"It is beyond the power of man to picture what man will be doing with the thunderbolt in radio work in the next ten years," he said.

He said that wireless speeded up for sending 200 words a minute is a possibility in the immediate future.

Tikker Reception of C. W.

With the detectors actually in use, the reception of Radio signals is effected by a telephone in which are heard the

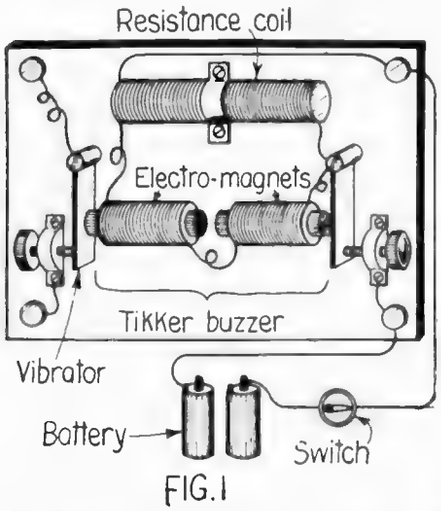


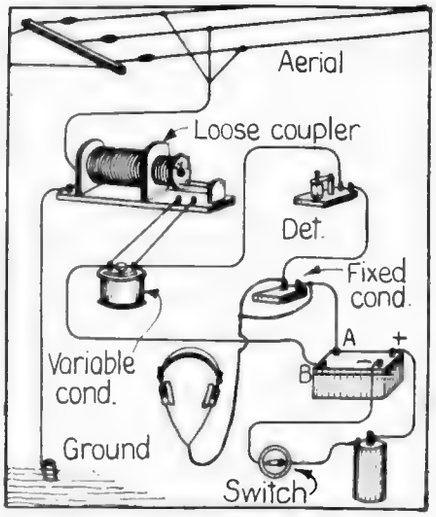
FIG. 1

This Drawing Shows How the Tikker Used for Receiving C. W. or Continuous Wave Signals, Is Built. It May Be Constructed From Two Buzzers With a Little Care.

noises of the groups of discharges of the spark transmitter. If the transmitting station sends some undamped waves, the frequency of which is too high to be audible by the human ear, only a little click is heard in the phone when the detector begins to be impressed by the wave trains; it is consequently impossible to discern a dot from a dash.

In this case, it is indispensable, for the reception of C. W. with a non-oscillating circuit, to have a means of cutting the continuous waves at regular intervals so that a sound of audible frequency is produced by the phones. The interrupter vibrator called "tikker" by its inventor, V. Poulsen, opens and closes the telephone circuit a certain number of times per second. The intermittent contacts of the vibrator enables the condenser shunting the phones to discharge at regular intervals in the receiving circuit a certain quantity of energy which makes the telephone receivers produce a sound corresponding to the frequency of the makes and breaks.

This disposition makes it possible to utilize in better conditions the resonance effects, and, if the tuning is properly adjusted, the detector may be dispensed with, the telephone receiver being impressed by the periodic discharge of the condenser. The tikker shown in Fig. 1 is composed of two electro magnets connected in series and shunted by a small resistance. Only one vibrator is used in the circuit of the battery connected to the binding posts marked "Positive" and "Negative," these being used to produce the make and break of the circuit. The electric current flowing through the second electro magnet attracts the blade of the second interrupter in synchronism with the first one. A screw making contact with the second blade and connected to a binding post completes the circuit of the tikker, which is included in the receiving circuit.



This Circuit Shows How the Tikker Is Connected on the Crystal Detector Type of Receiving Set, in Order to Hear C. W. or Arc Signals.

Adjustments

The binding posts marked + and — should be connected to a single element of a battery and the contact screw of the

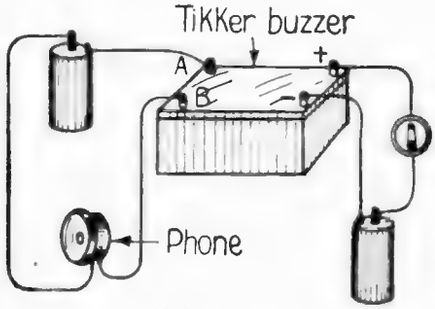


FIG. 2

Diagram Above Shows How to Connect Batteries and Telephone Receiver for Testing the Tikker.

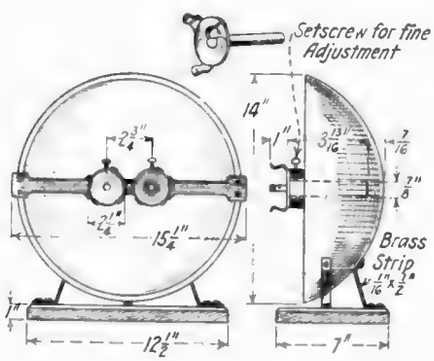
electro magnet nearest to these binding posts adjusted to obtain a regular vibration, producing a pure sound of the greatest possible amplitude. When the current is switched on, the blade of the second electro magnet vibrates at the same frequency as the first one and the screw making contact with it should be adjusted so as to make just the make and break. The best way to determine the proper adjustment of this screw is to connect in series with the blade and the screw a small battery and a telephone receiver, as shown in Fig. 2. The two contacts are then adjusted until a very clear note is heard in the phone.

The telephone receiver and the battery are then removed and in their place are connected the two wires from the receiving circuit, as shown in Fig. 3. The tikker may be connected in series with the antenna, but it is preferable to insert it in the secondary circuit, as the telephone condenser charged and discharged produces in the telephone a stronger sound.

Chopping Bowl Loud Talker

THE average amateur, although he would like very much to be the possessor of a radio loud talker, does not generally have the financial ability to obtain one, or if he has, will probably take pride in constructing one of his own. The following is a description of a loud talker, made from a chopping bowl and a few pieces of brass and wood, by Howard V. Brown:

First procure an ordinary wooden chopping bowl, 14 inches in diameter, and sandpaper it well inside and out. Secure a base 12½ inches long by 7 inches wide and 1 inch thick, and sandpaper this thoroughly. Stain both with any color desired and give one or two coats of varnish. A strip of wood for the front cross piece is next obtained, and cut to the shape shown. This should be finished in the same way as the bowl and base.



The Constructional Features of a Loud Talker Made from a Wooden Chopping Bowl Are Shown Herewith. The Size of the Phone Clips May Be Varied According to the Type of Receivers Used.

One and three-eighths inches on each side of the center of this cross piece a hole ⅞ inch in diameter is bored. As shown in the accompanying diagram, two holes are drilled and tapped at right angles to these ⅞-inch holes. Set-screws for these holes are provided. The cross strip is then fastened directly across the exact center of the chopping bowl.

Two pieces of brass are next obtained and a hole slightly less than ⅞ inch in diameter drilled in the middle of each. These pieces are then cut in the form of a clip, which will hold a receiver as shown. Two brass tubes, 3 13/16 inches long are provided, and one end of each is soldered to each of the clips.

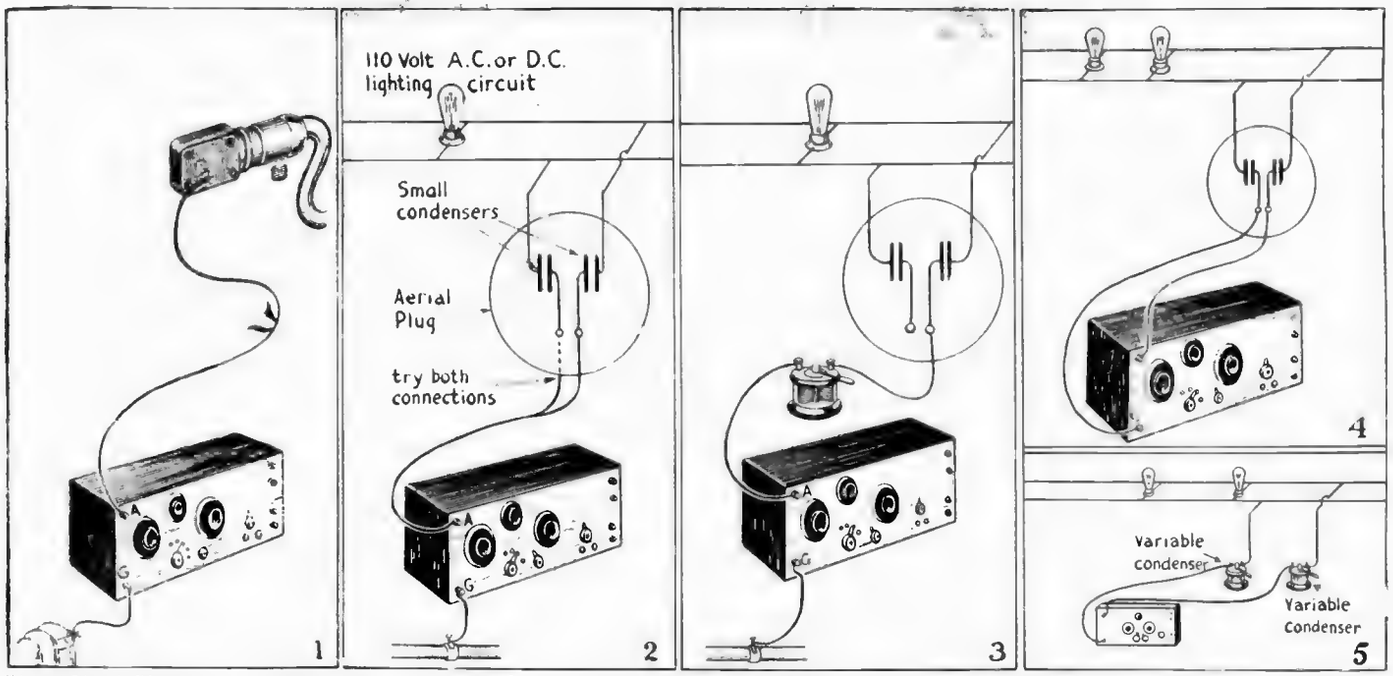
The completed holders are then inserted in the holes in the cross strip.

Three brass strips, 1/16 inch thick by ½ inch wide, are bent to the shape shown and the bowl mounted on the base by means of them. The finished instrument should now appear as shown in the photograph.

A pair of radiophone receivers are inserted in the clips and the set adjusted for the loudest signals. The brass tubes may be varied back and forth in the holes until maximum reflection of sound is obtained. By tightening the set-screws this adjustment is made permanent.

Using a detector and one or two steps of amplification, this loud talker should give results equal to any of the same general type on the market.

This Chopping Bowl Loud Talker When Properly Constructed and the Wooden Parts Well Finished, Should Make a Handsome Addition to Any Radio Station.



"Aerial Plugs" Which Are to be Screwed into a Convenient Lamp Socket Are Now Quite the Rage, and Just How These Plugs Operate is Evident from the Diagrams Herewith. Invariably the Aerial Plug Contains Two Small Condensers, Preferably with Mica Insulation. Fig. 1 Shows a Simple Connection of Receiving Set to Ground and Aerial Plug in Lamp Socket; Fig. 2 Shows Complete Circuit Through the Plug, and How the Aerial Wire is Tried on Both Plug Terminals to Find Best Results; Fig. 3 Shows Tuning Improvement by Placing a Variable Condenser in Series with Plug; Fig. 4 Shows Plug Used Without Ground Connection, While Fig. 5 Shows How to Duplicate Performance of Aerial Plug with Two Variable Condensers.

Radio Concerts from a Lamp Socket

By A. P. PECK

WITH the advent of radio in so many households throughout the country, there have come into being, like mushrooms over night, many different forms of a certain type of apparatus, in the form of an aerial attachment plug for electric light circuits. These instruments, which are designed to allow the electric light circuit to take the place of an outdoor radio antenna, come in various forms. Some of them are arranged to be screwed into the regular electric light socket, while others are in box form and are to be connected by a flexible wire to the socket. Binding posts or other means are provided for connection to the radio set.

The various manufacturers of these instruments were very mysterious at first, and claimed wonders from their "brain children." However, upon investigation these instruments were found to contain nothing more than two condensers, some of them well made, with mica dielectric, and others of very cheap construction, using paper dielectric.

The writer personally tested several of these instruments, and found that he could obtain almost as good results by using a 2 M.F. condenser in series with one side of the electric light line. In this case a vario-coupler was used as a tuner, and it was found that quite a large current passed through the primary of the coupler. This was when an A.C. line was used. On both A.C. and D.C. lines a distinct hum was audible, and in the case of A.C. became quite objectionable. In no cases were the results obtained as good as using a 75 foot 6 wire outdoor antenna.

The circuit shown in Fig. 5, which merely consists of two 43-plate variable condensers, one in series with each wire to the electric light line, was found to give fair results.

A certain type of instrument, which consists of an ordinary attachment plug with two slots in the end, into which two lugs, projecting from a small rectangular case are plugged, was tried out in various circuits. On either side of this small, rectangular case is a binding post. These allowed four different adjustments to be made. By using either one of the two posts, and by reversing the position of the lugs, different capacities may be obtained, and opposite sides of the line may be used.

The general connections for this type of plug are shown in Figs. 1 and 2. Fig. 2 shows a schematic view of the interior of the instrument.

By adding a variable condenser in the circuit, as shown in Fig. 3, sharper tuning was accomplished, and the hum was greatly reduced. This variable condenser also serves as a protective device in case one of the condensers should become shorted, because, if this happened, and this condenser were not present, current would run through the receiving set, thereby probably ruining the instruments.

Fig. 4 shows how one of these instruments containing two condensers may be used in place of both antenna and ground. When using this circuit, if signals are not heard at first, reverse the position of the lugs.

None of the above mentioned facts, however, are by any means new. These experiments were tried as far back as 1911, and the writer remembers having heard a crystal receiver tune in Brooklyn Navy Yard, using a small paper condenser in series with one side of the electric light line. In 1909 or 1910 there also appeared an article in *Modern Electrics* showing this trick.

We would suggest that anyone trying any of the above outlined experiments use very low amperage fuses in the circuit, so that if anything should go wrong, the fuses will break the circuit before much damage is done. It is also advisable to always use mica-dielectric condensers and avoid those using paper dielectric. This will decrease the danger of having the condensers break down.

Police Radio Successful

Experiments in the use of radio in the transmission of police messages have proved a complete success, George B. Carlson, Commissioner of Electricity for the City of Chicago, said recently in requesting an appropriation of $68,000 for radio equipment and personnel.

If the appropriation is granted, a new duplicate sending station will be installed on top of the City Hall. The eight high-powered bandit cars used by the Detective Bureau will also be equipped with both sending and receiving sets.

Mr. Carlson is working on a plan to extend the use of radio to every policeman on the force by supplying him with a miniature receiving set. Under the plan the city would be divided into ten zones, each with its own wave length, so that the central operator, by increasing or reducing the wave length could send messages concerning robbers or other crimes to the policemen in the districts in which the crimes occurred.

"I think the equipment of the bureau cars with radio sets will prove an important factor in arresting criminals," Chief of Police Fitzmorris said. "I doubt whether radio development is sufficient to warrant its use by ordinary patrolmen, however."

TRAIN RADIO RECORD

Train Radio Record

Broadcasting and receiving by radio recently on board a Frisco passenger train between Oklahoma City and Lawton, Okla., a distance of more than 100 miles, marked one of the longest distances over which radio telephone communication has been established on moving trains.

The train was fully equipped with receiving and transmitting outfits. Despite rain and electrical storms encountered along the route, constant communication was said to have been kept between the two points. Musical concerts were recorded so clearly that passengers were able to dance to the music.

The experiment was conducted through the co-operation of the Government radio station at Fort Sill, near Lawton, the Frisco Railroad and a radio concern in Oklahoma City.

Five Stage Amplifier on 110 Volts A.C.

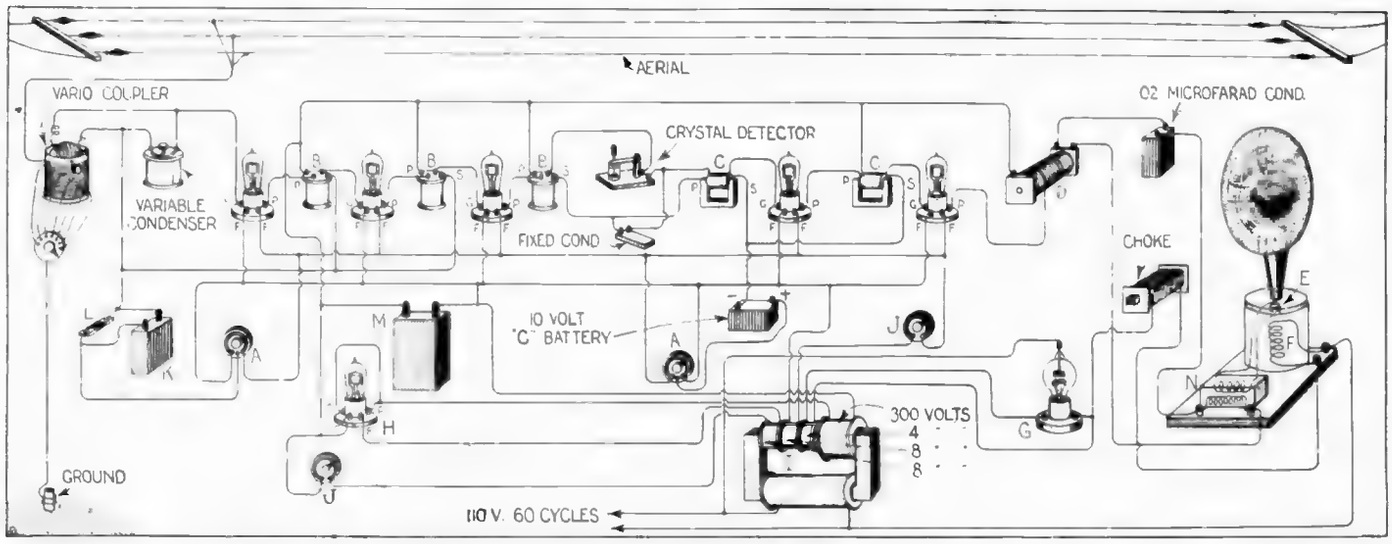


Fig. 1.—This Diagram Shows the Latest Hook-Up Used by a Bureau of Standards Expert in Operating a Five Vacuum Tube Receiving Set on 110 Volts, 60 Cycle Alternating Current, the Voltage Being Stepped Down Through a Suitable Transformer as Shown. The Letters in the Diagram Correspond With the Following Apparatus: A, Balancing Resistances; B, Radio Frequency Transformers; C, Audio Frequency Transformers; D, 1 to 1 Ratio Telephone Transformer; E, Armature of Loud Speaker; F, Field of Loud Speaker; G, Tungar Rectifier; H, Plate Voltage Rectifier; I, Power Transformer; J, Filament Rheostats; K, Condenser, 1 Microfarad; L, Leak Resistance, 2 Megohms; M, Smoothing Condenser, 10 Microfarads; N, Step-Down Transformer for Loud Speaker.

SEVERAL attempts have been made from time to time by various experimenters and radio engineers to operate vacuum tube receiving sets on alternating current, such as we have in our homes for lighting lamps and supplying heat for electric cooking apparatus, but as there is usually a considerable humming noise present when the sets are operated on alternating current, unless very finely tuned and balanced, the average radio enthusiast has stuck to his storage and dry batteries to supply the necessary filament and plate currents.

One of the U. S. Bureau of Standards radio experts, Mr. P. D. Lowell, has carried out some very interesting and startling experiments in the operation of a five-stage V. T. amplifier with crystal detector on 110 volts, 60 cycle A. C., and has reduced the residual hum due to the A. C. practically to zero, or to such an extent that it is not noticeable with ordinary strength of signals or speech. Mr. Lowell's contribution to science appears in the July number of the *Journal of the American Institute of Electrical Engineers*, and one of the most interesting facts brought out by Mr. Lowell is that more noiseless and perfect operation of vacuum tube amplifiers was obtained with the filaments lighted from low voltage A. C., supplied by a step-down transformer, than was given when the filament current was rectified through rectifier tubes. Those interested in this subject of operating audions on A. C., will do well to study the article giving full details entitled, "Operate Your Audions on A. C." by Elliott A. White on page 234 of the July, 1919, issue of this journal, which may be consulted at any public library if you do not have the copy.

The employment of a crystal detector, such as galena, may seem objectionable to those who have had experience with crystal detectors in general, owing to the fact that they are liable to get out of adjustment or become insensitive quite frequently, but this investigator has found many meritorious features in crystal detectors, when used in connection with a V. T. amplifier of two or more stages. For one thing the crystal detector used in place of a V. T. detector reduces the 60-cycle hum very considerably. As Mr. Lowell further points out, it is not necessary to make very careful adjustment of the crystal detector with this circuit, because the radio-frequency amplification preceding the detector usually gave sufficient signal strength so that a point of satisfactory sensitivity could easily be found. The crystal detector gave approximately as good amplification as the V. T. detector. Still better amplification and quieter operation was produced by using a ten-volt "C" battery in the grid circuit of the first audio-frequency stage. In some of the earlier experiments a plate "B" battery was used for convenience, but this was finally replaced by alternating current which had been rectified by means of an electron tube, and smoothed out by condensers with large capacities, as shown in the accompanying diagram, Fig. 1

Referring to the complete circuit of the five-stage V. T. amplifier with crystal detector, shown in Fig. 1, it is seen that either a loop aerial or the regular out-door antenna may be employed. The outside antenna is here shown, used in connection with a vario-coupler or loose coupler, for tuning the signals or speech to a maximum strength. This amplifier is not of the regenerative type, as here shown, but it has been found effective for the reception of undamped waves, etc., when used with a separate V. T. heterodyne. The five V. T.'s used for amplifying in the first three radio-frequency stages and in the last two audio-frequency stages should be U. V. 201 amplifier tubes or their equivalent. The first three transformers are radio-frequency units, while the transformers connecting the two audio-frequency stage V. T.'s and the crystal detector are iron core audio-frequency transformers. A small condenser of about .01 M. F. is placed across the primary of the audio-frequency transformer connected with the crystal detector, as shown. It was found advantageous to couple the Magnavox loud-talker to the plate circuit of the fifth V. T. by means of a one-to-one ratio telephone transformer, D, Fig. 1. An .02 M. F. condenser was connected in series with this telephone transformer, and with the primary terminals of the Magnavox transformer N, which is found mounted on the base of this type of loud-talker. E is the moving coil of the loud-talker, while F is the field magnetizing coil of the Magnavox, with a choke coil connected in series with the filament and plate of a Tungar rectifier, G. The impedance of the field coil was found sufficient to smooth out the pulsating current, so that the hum was not annoying. This hum was further reduced by the aforementioned one-to-one transformer and series condenser, shown in Fig. 1.

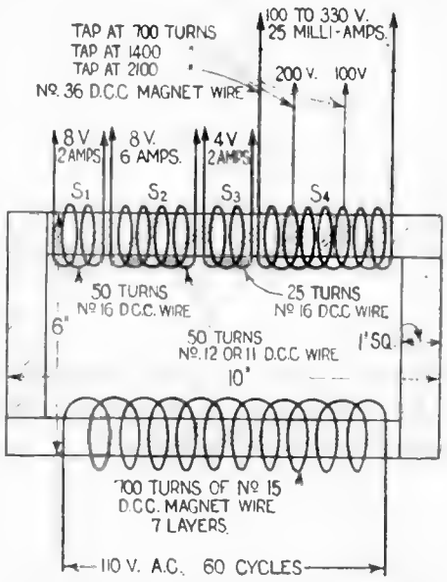


Fig. 2.—Details are Shown Above of Special Step-Down Transformer to be Used in Operating Five Tube Receiving Set on 110 Volts, 60 Cycle A. C. Instead of Building This Transformer With All the Different Secondary Windings on It, Some of the Low Voltage A. C. Supply for the V. T.'s May be Furnished by Toy Step-Down Transformers, Available on the Market.

The rectifying tube H, for the 300 A. C. for the plate may be a Tungar tube, or else a three-electrode audion with the plate and grid connected together, as shown, to form the cold electrode for rectifying. The large condenser M is of ten microfarads capacity and may have waxed paper or mica dielectric, but preferably mica. The experimenter might try different arrangements than this using a high voltage D. C. dynamo to supply the plate current, for example.

The balancing resistances or potentiometers A have about 200 ohms resistance. All of the V. T.'s in the amplifying stages have their filaments controlled by a power rheostat from the 8-volt A. C. circuit.

The low A. C. potentials required may be supplied by properly connecting to the terminals of a toy step-down transformer of suitable size, using a plate "B" battery; or else a small transformer having a 250 to 300 volt secondary, or this can be made readily

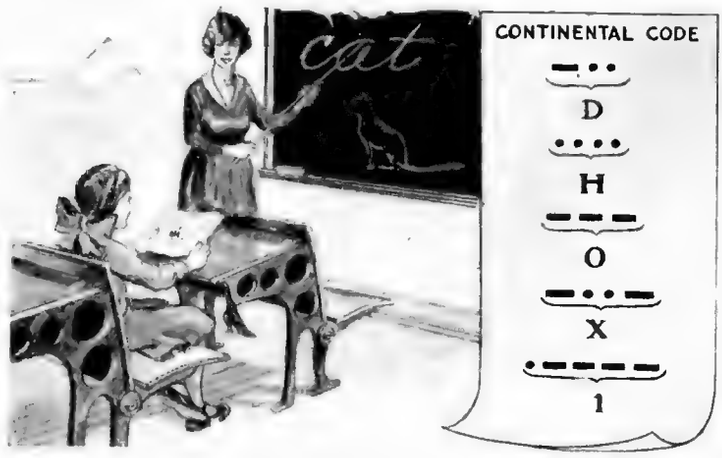
(*Continued on page* 506)

Radio for the Beginner

By ARMSTRONG PERRY

No. 7. HOW TO LEARN THE RADIO CODE AND OBTAIN GOVERNMENT AND COMMERCIAL MESSAGES

THE man who, having been born in America, neglects to learn to read English, is looked down upon by his neighbors. So is the resident foreigner who shows no desire to learn the language of our country. In the same class, unconsciously, may be the man who will not try to understand the code messages that his radio receiver brings in. The desire to know is the impelling force that has raised humanity from the darkness of savagery, and the willingness to remain ignorant is the retarding influence that gives civilization its hardest battles. Even a country horse will prick up his ears and try to see what is going past.



Following Present-Day Teaching Methods, in Which Children Do Not Learn to Recognize the Word Cat, Dog, Etc., by Spelling It Any Longer, But Are Taught to Recognize the Word by Illustration With a Picture, or Otherwise, so That They Can Recognize and Pronounce Words Long Before They Can Spell Them, We Must Do This With the Code, Says Mr. Perry; We Must Learn to Recognize the Code Combinations as a Group, as Indicated at the Right of the Illustration, and Not by Single Dots and Dashes.

"Why should I learn code?" asks the radio concert listener. Because code is an essential factor in the transmission of important messages; because code carries farther than voice and reduces the chances of error; because a copied code message is evidence that will be accepted in court, while a verbal report of a telephone message is considered as hearsay; because you cannot get a radio license without knowing code; because the learning of code is a stimulating mental exercise that develops sharp ears and alert minds. Folks listen in on party lines for personal matters of no importance; with a knowledge of code you can listen in on the world and gather information that is worth dollars.

Learning code is not as difficult as making up your mind to do it. I have seen a group of fifty Scouts learn the International Morse alphabet in thirty minutes—learn it so well that they could write or read any one of the dot-and-dash letters.

The first step is to select a station that sends code at slow speed and that can be heard at scheduled times with good signal strength. Throughout the East NAA, the Navy station at Arlington, Virginia, is the "Old Faithful." At 11.55 a. m. and at 9.55 p. m. Standard time, it opens up unfailingly and even crude apparatus will bring it in at considerable distances. There are other Navy stations all around the coast. No American home is out of range of the Navy Communication Service. At four o'clock, eight o'clock and twelve o'clock, day and night, chances are good for picking up a code broadcast from the nearest Navy station. NAH, the New York Navy station, transmits an Amateur Broadcast daily at 6.45 p. m. at slow speed and on two wave lengths, 175 meters and 1,832 meters. The Army has a broadcasting station at each Corps headquarters that can be heard throughout the Corps area. The Post Office Department has a string of stations across the continent from Washington to the Pacific. Many radio schools and the radio departments of a number of state and private universities maintain code schedules for beginners. Any one of the broadcasting stations that shoot out concerts would be willing to send a slow code message daily if there were a demand for it.

Information concerning local code schedules can be gathered from daily papers or local radio dealers. For five cents, a copy of the Radio Service Bulletin can be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., giving the schedules for the weather forecasts and other broadcasts from Navy stations. The applicant should state that he wants that information, as it is not printed in every issue of the bulletin.

Tune in your station at the scheduled time. For example, you get NAA at 9.55 p. m. (As NAA transmits on 2,650 meters, those who have only short-wave receivers will need loading coils to increase their tuning range. These can be obtained of any radio dealer. They will be useful in bringing in other stations such as the Army station at Fort Wood, N. Y., and the Post Office stations. From Fort Wood valuable radio instruction is broadcast to members of the Amateur Radio Reserve and other amateurs as well as excellent entertainments, on 1,400 meters. The Post Office stations send out market reports on live stock and farm produce.) For five minutes NAA ticks off the seconds and finishes with a long dash exactly at 10 o'clock. During this time the receiver can be adjusted for maximum results. There follows a coded weather report. By writing down in advance the letters used to designate the reporting weather stations, the beginner can use this report as an easy step in his progress. They are: J, S, FP, ML, T, NY, DB, LB, CH, H, AV, C, B, AT, SL, LR, NV, DU, M, D, F, CN.

It is easy to identify a letter when you know what is coming and you will gain confidence from knowing that you will get these letters at least. Following each letter or pair of letters comes a string of five figures.

In a very few evenings a beginner finds this weather report easy to copy. The translation of the figures is found in the Radio Service Bulletin referred to above.

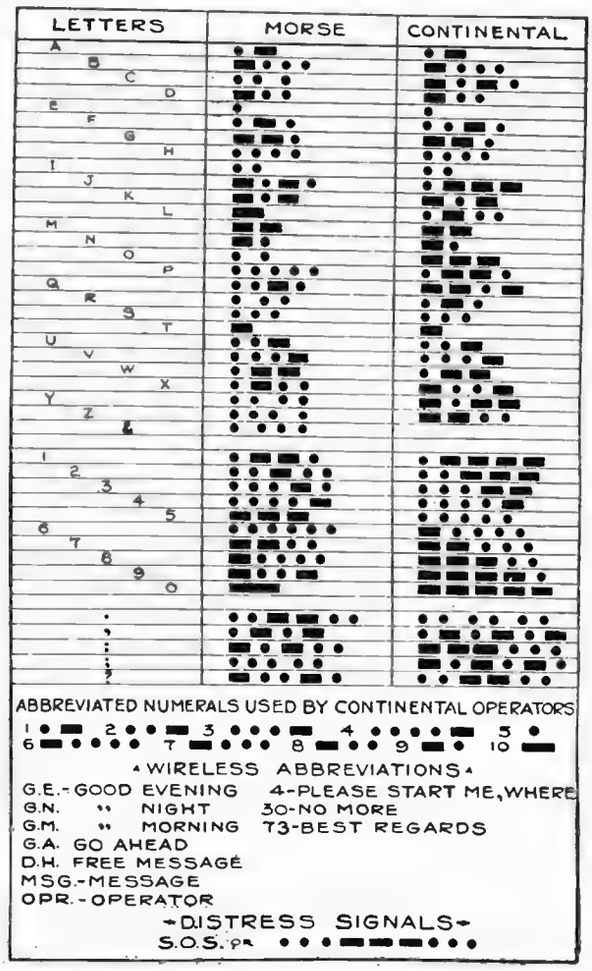
Following the coded reports comes a weather forecast for the Atlantic Coast in plain English. It starts something like this:

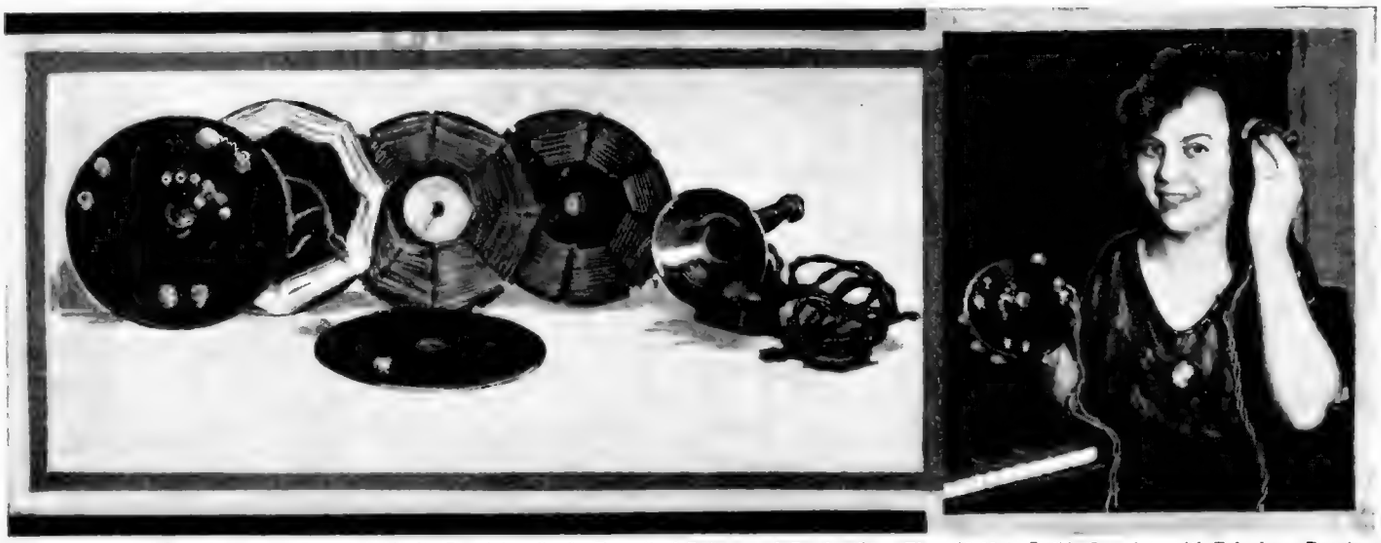
"Winds off the Atlantic Coast. North of Sandy Hook moderate to fresh west winds and fair weather Sunday. Sandy Hook to Hatteras." and so on. The form of the message is always the same and in a short time the beginner is so familiar with it that he follows it easily and only has to make an effort to concentrate on the three or four words that change from day to day. The "flying weather" which follows predicts local weather in six zones, telling what to expect at the surface and aloft.

By the time you are copying these routine messages with a fair degree of ease you will be able to pick up a good deal of the hydrographic report and the Shipping Board's orders to its vessels, which follow.

(*Continued on page* 508)

The Morse and Continental Telegraph Characters Are Shown in the Chart at the Right. As the Author Points Out in the Present Article it is All Very Well to Memorize the Code (the Continental is the One Used in Radio Today), But a Further Effort Must be Made to Remember the Combinations of Dots and Dashes for Each Letter or Figure as Groups. For Instance, When You Hear Three Dots You Should Know that it Represents the Letter S "Instantly"; and Until You Have So Thoroughly Memorized and Co-related the Code Characters Corresponding to a Certain Letter, it is Difficult to Receive and Read Signals at High Speed.





The Picture at the Left Shows the Ingenious Radio Receiving Outfit, Described Below, and Costing Less Than $3.00 to Build, Complete with Telephone Receiver. This Compact Radiophone Receiving Set is Shown in Use by Mrs. Copeman in the Picture at Right.

The Simplest Radio Outfit Contest

By FRANK COPEMAN

(WINNER OF FIFTH PRIZE, $25.00 IN $300.00 RADIO RECEIVING CONTEST)

HEREIN is presented a simple, cheap and easy-to-make radio outfit; besides having all the advantages of a regular crystal set, it can be constructed without the aid of tools, from material found about the ordinary household and is small enough to be carried in the coat pocket without discomfort. The secret of the success of this set lies in high insulation throughout and the method of winding the coils used for tuning. The novice is apt to wind his coils upon wood or cardboard, thereby losing much of the received energy by leakage.

For this set then some better insulator than wood or paper will be used. First are needed five of those phonograph disk records, five inches in diameter that sell for a dime. They can be found in almost any home and are just the thing for building this set. Three of the records are used as forms for a tuner. They are slotted as shown in the diagram, using a scrap of tin or an old knife heated in a gas flame to melt and at the same time cut from the edge toward the center. The disks thus cut are now ready to be wound with No. 26 or 28 S. C. C. wire obtained from an old medical coil secondary or an old bell magnet, or it may be bought for a few cents. The wire is wound spider-web fashion. Coils thus wound are more efficient than any single or multi-layer coil and can be more quickly wound by a novice, as the wire has no tendency to slip off once in place.

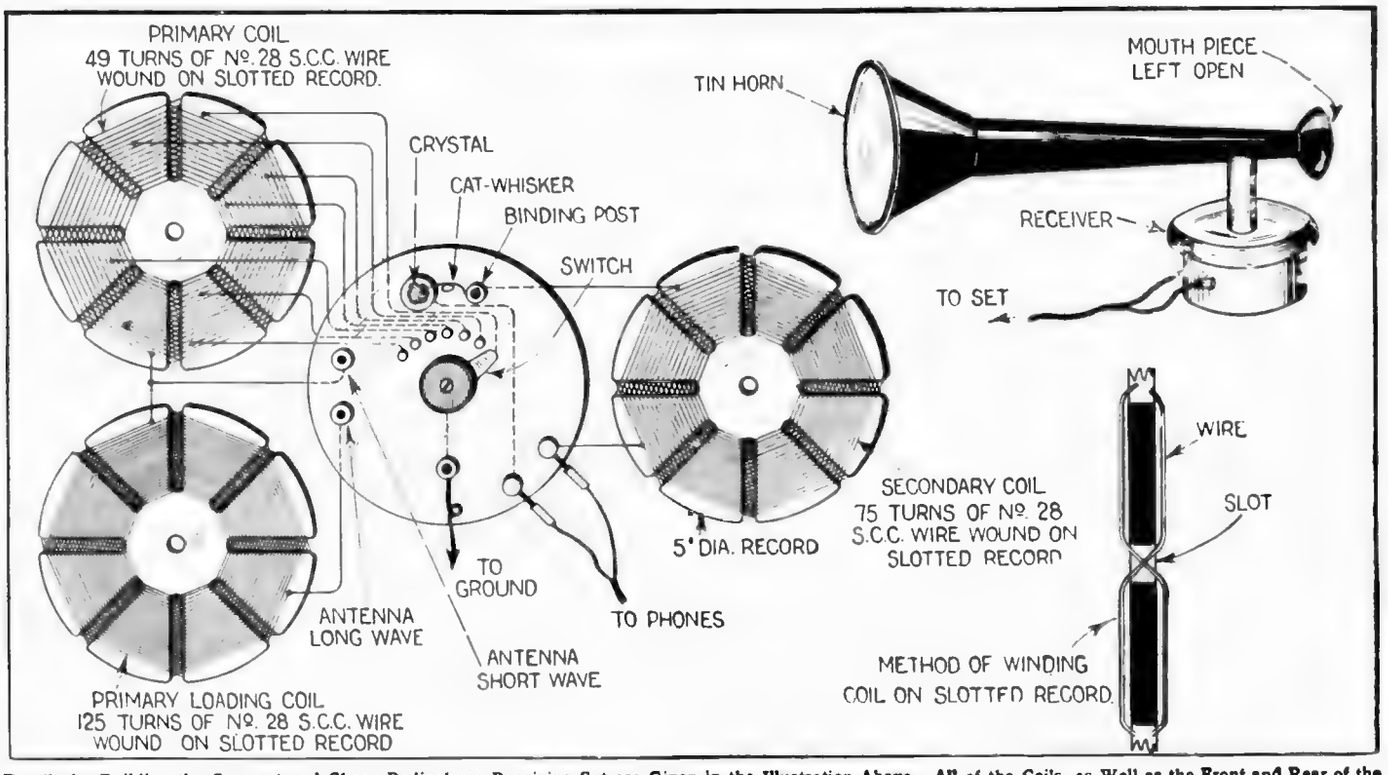
Record No. 1 is the primary and is wound with 49 turns, a tap being taken off at every seventh turn. Record No. 2 is the primary loader and has 125 turns; no taps. Record No. 3 serves as the secondary and is wound with 75 turns; no taps.

The other two records serve to dress up the set, giving it a neat appearance and also to give support for four binding posts made from brass screws and nuts, and the detector made as shown from a brass bolt and nut to hold a short length of copper wire for a cat-whisker, and a cup holding a galena crystal. The crystal is best bought already mounted and tested.

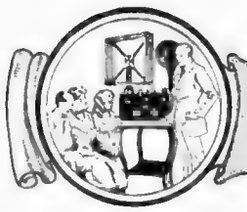
All holes can be made in a jiffy by the aid of the hot point of a darning needle or nail. The rotary switch is constructed from a brass bolt and nuts, a strip of brass for the blade and a composition knob from an ink bottle or an extra fine knob off the end of a player piano roll. A hole can be made through the center with a hot nail.

Six switch points made from flat headed brass screws complete the set and it is ready

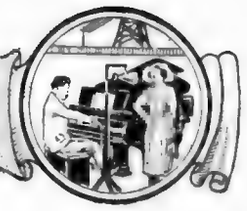
(*Continued on page* 502)



Details for Building the Compact and Cheap Radiophone Receiving Set are Given in the Illustration Above. All of the Coils, as Well as the Front and Rear of the Cabinet, are Made from Small Five-Inch Phonograph Records, Three of the Records Being Slotted as Shown, and the Coils Wound on Them in Spider-Web Fashion, So as to Minimize Distributed Capacity. At a Distance of a Few Miles from Radiophone Broadcasting Stations This Set Will Give Sufficiently Loud Results in the Receiver to Enable the Music and Speech to Be Heard Through a Tin Horn Placed Tightly Against the Receiver, as Shown in the Upper Right-Hand Drawing.



RADIO BROADCAST



THERE are so many broadcasting stations which have forwarded information, that we regret we have only space enough to print a very few. Those stations which have been courteous enough to submit photographs, will find that the photos will be published in due time. The stations listed on this sheet will not be published in the next issue. We would suggest to our readers that the map locations indicated on this page are for the special supplement map given free with the May issue of SCIENCE AND INVENTION. At a great expense this list of the stations has been practically completed as far as commercial broadcasting stations are concerned. We will present our readers with additional information on the new stations as it is brought to our attention. Address all communications to Editor Radio Broadcast, c/o SCIENCE AND INVENTION MAGAZINE, New York City.

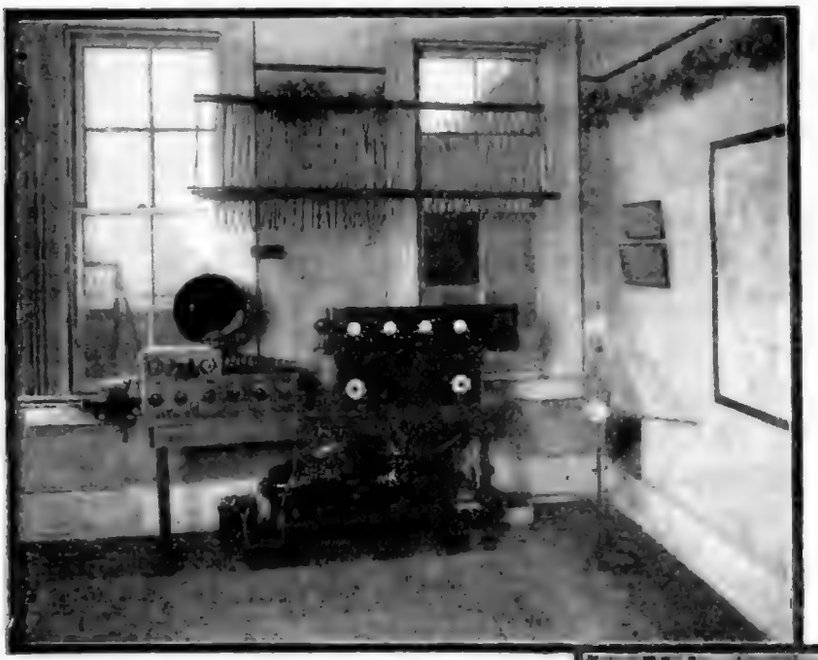
CONTINUED FROM LAST MONTH

Call Letter	Name	City	State	Wave Length	Map Location
KON	Holzwasser, Inc. Daily except Sunday, 4.00-5.00 and 8.15-9.00 P. M., news, concerts. Sunday, 10.00-11.00 A. M. and 4.00-5.00 P. M., and 8.15-9.00 P. M. church services. Consistent range 200 miles.	San Diego,	Calif.	360	V-7
KOP	Detroit Police Dept. Broadcast police information of all kinds. Maximum range 250 miles.	Detroit,	Mich.	360	L-39
KOQ	Modesto Evening News	Modesto,	Calif.	360	O-3
KPO	Hale Bros. Lectures, market reports, etc., 9.00-10.00 A. M., 11.00-12.00 M., orchestra and vocal music and other entertainments.	San Francisco,	Calif.	360	O-3
KPPT	Southern Electrical Co.	San Diego,	Calif.	360	V-7
KQI	University of California. Station not yet installed. Broadcast will consist of educational programs, lectures, etc.	Berkeley,	Calif.	360	O-3
KQL	Arno A. Kluge	Los Angeles,	Calif.	360	T-6
KQP	Blue Diamond Elec. Co. Daily except Sunday 7.00-7.30 P. M., news. Monday, Wednesday and Friday, 8.30-9.15 P. M., concert. Pacific time. Consistent range 100 miles.	Hood River,	Ore.	360-485	E-6
KQT	Elec. Power & Appliance Co.	Yakima,	Wash.	...	D-7
KQV	Doubleday-Hill Elec. Co. Daily except Saturday and Sunday, 12.00-12.30 P. M., 2.30-3.00 P. M., evenings on Monday, Wednesday and Friday, 10.00-11.00 P. M., Saturday, 12.00-12.30 P. M., Sunday, 4.00-5.00 P. M. Eastern time, daylight saving. Consistent range 100 miles.	Pittsburgh,	Pa.	360	N-42
KQW	Chas. D. Herrold. Music and church services are transmitted by telephone to the laboratories, and then re-transmitted via radio. Equipment, 50-watt phone with facilities for connecting to the telephone line. 1,500 miles radius. Wednesday, 7.30-8.15. Sunday, 5.00-6.00 P. M.	San Jose,	Calif.	...	P-4
KQY	Stubbs Electric Co. Daily, 1.00-2.00 P. M., 6.00-7.00 P. M., general broadcast. Pacific time. Maximum distance heard 200 miles, using 4 5-watt power tubes. Consistent range 100 miles.	Portland,	Ore.	360	E-5
KRE	Maxwell Elec. Co. Sunday, 1.00-2.00 P. M. and 6.00-7.00 P. M., concert. Pacific time. Consistent range 100 miles.	Berkeley,	Calif.	360	O-3
KSC	O. A. Hale & Co.	San Jose,	Calif.	360	P-4
KSD	Post Dispatch. Broadcasts afternoon and evening. 4.00 P. M., news, market reports, musical selections; 7.45 P. M., vocal and instrumental numbers, recitations, lectures, addresses, baseball scores, etc. Central time. Consistent range 1000 miles.	St. Louis,	Mo.	360	P-33
KSL	The Emporium. Broadcasts 10.00 and 11.00 A. M. and 2.00-3.00 P. M. Morning instruction in baking and cooking and three tested recipes. How to dress. Baby hygiene and dancing for the child. Afternoon—very prominent speakers. Music interlude. Piano and phonograph avoided as much as possible. Maximum 200 miles. Pacific time.	San Francisco,	Calif.	360	O-3
KSS	Prest & Dean, Radio Research Lab. Daily except Sunday, 3.30-4.30 P. M. News items of interest to Long Beach, musical concerts and miscellaneous lectures. Pacific time. Maximum distance heard 250 miles.	Long Beach,	Calif.	360	U-6
KTW	First Presbyterian Church. Sunday 11.00 A. M. to 1.00 P. M., 7.30-10.00 P. M. Church services. Pacific time.	Seattle,	Wash.	360	C-6
KUO	Examiner Printing Co. Daily except Sunday, 3.00-3.30 P. M. and 5.30-6.45 P. M., news, etc. Sunday, 5.00-6.00 P. M., news, etc. Maximum range 1500 miles.	San Francisco,	Calif.	360	O-3
KUS	City Dye Works & Laundry Co. Educational lectures on textile fibres, covering the four classes of fibres, growth, origin, physical and chemical properties and general outline of uses for each. Then lectures on chemicals that enter into manufacture and treatment of said fibres. Also music, instrumental and vocal, by company choral society. 500 miles.	Los Angeles,	Calif.	360	T-6
KUY	Coast Radio Co., Inc. Program divided into: (a) Radio lectures, building, improving, and designing sets for home use. (b) Farmers lectures' instruction and amusement by best lecturers in state for ranches, orange growers and walnut men. (c) Music, phonograph, piano and orchestra. Heard 1170 miles.	El Monte,	Calif.	360	S-6
KVQ	J. C. Hobrecht. Operating in connection with Sacramento Bee Newspaper. Every afternoon from 5.30-6.30 press notices and music. Wednesday and Saturday, 8.00-9.00 P. M., music. Pacific time. Equipment 5 5-watt tubes, 2 oscillators, 2 modulators and 1 speech amplifier. 1000 miles.	Sacramento,	Calif.	360	N-4
KVT	Boulevard Express. No broadcast. Station not yet completed.	Los Angeles,	Calif.	485	T-6
KVW	Boulevard Express. No broadcast. Station not yet completed.	San Diego,	Calif.	485	V-7
KWG	Portable Wireless Tel. Co. Broadcasts news and music, 4.00-5.00 P. M. daily except Sunday, concert Tuesday and Friday, 8.00-9.00 P. M. Concert 2.00-3.00 P. M. Sundays. Transmitter uses 2 50-watt power tubes, and the antenna current is 3 amperes. Have been heard in Honolulu and Alberta, Canada.	Stockton,	Calif.	360	O-4
KWH	The Examiner. Daily except Saturday, 12.30 P. M., music, news, crop reports. 5.30-6.30 P. M., music, news. Sunday, 2.00-3.00 P. M., sacred music.	Los Angeles,	Calif.	360	T-6
KXD	Modesto Herald Pub. Co. News every evening 6.30-7.00, also musical programs. Sermon and sacred music Sunday 1.00-2.00 P. M. Approximate range 150 miles.	Modesto,	Calif.	345	O-3
KXS	Braun Corp. Station under construction. Broadcasting will be principally educational lectures.	Los Angeles,	Calif.	360	T-6

Call Letter	Name	City	State	Wave Length	Map Location
KYF	Thearle Music Co. Station not broadcasting yet but furnishes the music for station KPPT the broadcasting station of the Southern Electrical Co. and two newspapers, the Morning Union and Evening Tribune.	San Diego,	Calif.	360	V-7
KYG	Willard P. Hawley, Jr Tuesday and Thursday, 9.00-10.00 P. M. concert. Saturday, 8.00-9.00 P. M. concert. Pacific time.	Portland,	Ore.	360	E-5
KYI	Alfred Harrell Operating for Bakersfield Californian.	Bakersfield,	Calif.	360	R-6
KYJ	Leo J. Meyburg. For Hamburger's Department Store. Daily concerts 4.00-5.00 P. M., also Monday, Thursday and Saturday 8.00-9.00 P. M. In addition reports on stock market, weather conditions and news are broadcasted. Have been heard in Panama, Alaska and the Hawaiian Islands. Pacific time. In connection with this station there is a radio school, which is free. 300-400 pupils; night school for adults.	Los Angeles,	Calif.	360	T-6
KYW	Westinghouse Elec. & Mfg. Co. Daily, except Sunday, 9.35 A. M., market 10.00 A. M., and half hourly thereafter until 1.00 P. M., 1.20 P. M., closing market quotations. 2.15 P. M., news and market reports. 3.00 P. M., progress of ball games every half hour. 4.15 P. M., news, market and stocks. 6.30 P. M., news, final market, financial and baseball reports. 7.30 P. M., baseball reports. bed-time stories. 7.45, special features. 8.00-9.00 P. M., musical program. 9.00, news and sports. Sunday, 3.30 P. M., chapel services, sacred music. Central daylight saving time.	Chicago,	Ill.	360-485	M-35
KYY	Radio Telephone Shop	San Francisco,	Calif.	360	O-3
KZC	Public Market Co. Broadcasts retail prices of foodstuffs every day, from 10.30-11.00 A. M., and 6.45-7.15 P. M. Music is also broadcasted as well as talks on food values, health, sanitation, etc. Transmitter uses 4 5-watt power tubes. Maximum distance heard 50 miles. Pacific time.	Seattle,	Wash.	360	C-6
KZI	Irving S. Cooper	Los Angeles,	Calif.	360	T-6
KZM	Preston D. Allen. For Western Radio Institute and Hotel Oakland. 7.15 P. M., news on week days. 7.30-8.15 P. M., music on Tuesdays. 8.15-9.00 P. M., music on Fridays. Sermons Sunday. Pacific time.	Oakland,	Calif	360	O-3
KZN	Deseret News. Broadcasts twice daily at 3.00 and 8.00 P. M., giving news items, weather reports, baseball scores and musical programs. Power used 250 watts. Has been heard in Oakland, Calif	Salt Lake City,	Utah.	360-485	M-13
KZV	Wenatchee Battery & Motor Co	Wenatchee,	Wash	360	C-8
KZY	Atlantic Pacific Radio Supply Co. Daily except Sunday, 3.30-4.30 P.M., concert. 6.45-7.00 P. M., news. Wednesday, 7.30-8.15 P. M., concert. Saturday, 8.15-9.00 P. M., concert. Sunday, 11.00-12.15 P. M., church service, 3.00-4.00 P. M., concert. Pacific time.	Oakland,	Calif.	360	O-3
WAAB	Times Picayune. May 13th discontinued its broadcasting service indefinitely.	New Orleans,	La	360	AA-34
WAAC	Tulane University.	New Orleans,	La	360	AA-34
WAAD	Ohio Mechanics Institute.	Cincinnati,	Ohio.	360	P-38
WAAE	St. Louis Chamber of Commerce	St. Louis,	Mo.	360	P-33
WAAF	Union Stock Yards & Transit Co.	Chicago,	Ill	360-485	M-35
WAAG	Elliott Electric Co. Broadcast baseball scores, instructive talks on radio and instrumental and phonograph music. 5-watt transmitter used with a maximum range of 65 miles. Daily except Sunday, 7.30-9.00 P. M., on central time.	Shreveport,	La.	360	X-30
WAAH	Commonwealth Elec. Co. Every evening beginning at 8.00, baseball scores, news, concerts, etc., are broadcasted. Maximum range, 700 miles.	St. Paul,	Minn	360	E-30
WAAJ	Eastern Radio Inst Monday, Wednesday, Friday, 9.00-10.00 P. M., concerts, eastern time. Power 15 watts. Maximum range 50 miles.	Boston,	Mass	360	J-50
WAAK	Gimbel Bros.	Milwaukee,	Wis	360	K-35
WAAL	Minn. Tribune & Anderson Beamish. News, baseball scores, markets, every night, 9.40-10.00 P. M., and concerts by well-known artists on alternate Friday and Saturday nights, from 7.50 to 9.00 P. M. Heard at Conn. 2000 miles.	Minneapolis,	Minn.	360	H-30
WAAM	I. R. Nelson Co Now working every fifteen minutes after the hour to 30 minutes from 9.15-4.30 daily. 80 miles daylight (maximum).	Newark,	N. J.	360	M-48
WAAN	University of Missouri	Columbia,	Mo	360	P-31
WAAO	Radio Service Co	Charlestown,	W. Va.	360	P-41
WAAP	Otto W. Taylor.	Wichita,	Kansas	360	R-26
WAAQ	New England Motor Sales Co. Daily except Sunday, 9.30 A. M. to 5.30 P. M., every half hour. Eastern daylight saving time. 600 miles consistent.	Greenwich,	Conn	360	L-48
WAAR	Groves-Thornton Hardware Co	Huntington,	W. Va	360	P-41
WAAS	Georgia Radio Co.	Decatur,	Ga	360	V-40
WAAT	Jersey Review. Wednesday, 7.00-8.00 P. M., concerts, lectures. Sunday 7.00-8.00 P. M., church service, concert. 70 miles consistent.	Jersey City,	N. J.	360	M-48
WAAV	Athens Radio Co. Daily, 7.00-9.00 P. M., general program. Central time.	Athens,	Ohio.	360	O-41
WAAW	Omaha Grain Exchange Broadcast market reports every hour. Also weather and any news reports which might be of interest to farmers. At 8.00 P. M. final market reports are given, followed occasionally by concerts put on by local talent.	Omaha,	Neb.	360	M-28
WAAX	Radio Service Corp.	Crafton,	Pa.	360	M-43
WAAY	Yahrling-Rayner Piano Co. Various kinds of instrumental music, speeches and news.	Youngstown,	Ohio.	360	M-42
WAAZ	Hollister-Miller Motor Co. Chicago and Kansas City Board of Trade market quotations every 30 minutes from 8.45 A. M. to 12.15 P. M., music from 7.00-8.00 P. M. daily. Daylight radius 250 miles. Central time.	Emporia,	Kansas.	360	Q-27
WAH	Midland Refining Co	El Dorado,	Kansas	360-485	R-27
WBAA	Purdue University. Educational lectures by members of the university staff, and occasionally special programs of music. No regular schedule. Maximum distance day, 75 miles, night, 150 miles.	West Lafayette,	Ind.	360	O-36
WBAB	Andrew J. Potter Daily except Sunday, 7.00-8.00 P. M., concerts, baseball, weather, news, bed-time stories. Sunday, 6.30-7.30 P. M., church services, etc. Eastern time.	Syracuse,	N. Y.	360	J-45
WBAD	Sterling Elec. Co. & Journal Ptg. Co. Bond and stock market reports every morning, 9.30. Vocal and instrumental numbers, speakers, two nights per week. Lasting two hours. Maximum distance heard 200 miles. Central time.	Minneapolis,	Minn.	360	H-30
WBAE	Bradley Polytechnic Inst Monday, Wednesday and Friday at 2 and 8.30 P. M., general news, baseball scores and other information of general interest. Daily at 9.15 A. M., weather forecast on 485, and every evening a musical concert at 8.00 on 360. Maximum distance heard approximately 1000 miles.	Peoria,	Ill	360-485	N-34
WBAF	Fred M. Middleton	Moorestown,	N. J.	360	M-47
WBAG	Diamond State Fibre Co. Market and crop reports covering within a 100-mile radius of Philadelphia, between the hours of 12.00 and 12.15 P. M. on a 485 meter wave. Occasional entertainment program. No regular schedule. Radiates 6 amperes. Eastern time.	Bridgeport,	Pa.	360-485	M-47

(To be continued in the next issue—Save these, as they will not be repeated)

PHOTOS OF BROADCASTING STATIONS



SERVICE RADIO EQUIPMENT CO. TOLEDO, OHIO—"WJK"

"WJK," the Broadcasting Station of the Service Radio Equipment Co., Has Been in Action About Five Months, and Has Made an Enviable Record for Itself in That Time. A Composite Transmitter of 100 Watts Power is Used, and Has a Consistent Range of 400 Miles, Although They Have Been Reported QSA (Very Distinct) Over 800 Miles Away on Many Occasions. The Operating Room is Located Directly Above the Studio, Which Location Tends Toward Greater Efficiency. This Room Contains a Complete Receiving Set in Addition to the Transmitting Apparatus. The Former May Well be Considered to be an Essential Part of an Up-to-Date Radiophone Broadcasting Station, as it Permits the Operator to Keep in Touch With Amateurs Who Have Transmitters. They Can Act as a Check on the Broadcasting Station, Telling the Operator How His Modulation, etc., is. The Operator May Also Listen in Before Broadcasting and Be Sure That He is not Interfering With Another Nearby Station on the Same Wave Length. The Transmitting Set Uses Five 50 Watt Power Tubes; Two as Oscillators, Two as Modulators, and One as a Speech Amplifier. These Tubes are Supplied With a Plate Voltage of 750 to 1000 Volts and They Deliver a Current of 4 1/2 to 5 Amperes to the Antenna. A Cage Type Antenna and Tuned Counterpoise are Used. This Station is Located in the Heart of the Business Section of Toledo, and Consequently Has Many Obstacles to Overcome, the Greatest of Which is a Very High Resistance Ground. A Great Deal of Trouble Was Encountered From This Source, and Much Experimenting Was Necessary Before a Satisfactory Counterpoise System Was Erected to Overcome the Trouble.

THE MICROPHONE ROOM OF "WJK"

The Very Greatest of Care Was Exercised in Designing and Arranging the Microphone Room, or "Artists' Studio" of WJK in Order to Produce as Nearly Perfect Results as Possible. Heavy Felt Draperies Cover All the Walls as Well as the Ceiling, and a Soft Rug Covers the Floor. This is Done to Reduce the Echo From the Walls to a Minimum, and to Deaden the Sounds of Persons Walking and Moving Around the Room While Transmission is Going On. The Lighting Effects in This Studio Are Very Soft and Restful, and There is Nothing Glaring or Brightly Colored Which Would Distract, Even for a Moment, the Attention of the Artist While Performing, Whether Talking, Singing, or Playing Before the Microphone. This Latter Instrument May be Seen on Its Adjustable Stand at the Far End of the Room. To the Right of It Stands the Phonograph Which is Used to Render the Latest Records to the Radio Audience. In the Foreground is the Piano Which is Used for Accompanying Singers as Well as Various Bands and Orchestras Which Perform at WJK. The Arrangement of the Other Furniture is Very Tasteful and in Strict Accordance With the Principles of Harmony Spoken of Above. We Feel Sure That Every Artist and Entertainer Who Performs for the Service Radio Equipment Co. Does Not Easily Forget the Simple Beauty of Their "Artists' Studio."

DORON BROS. ELECTRIC CO. HAMILTON, OHIO—"WRK"

The Antenna, Which is 125 Feet High, is of the Cage Type, Composed of 6 Wires 100 Feet Long. Leads are Taken From the Ends and From the Center, Making the Aerial System Multiple Tuned. A Counterpoise 90 Feet Long and 18 Feet Above the Ground is Used. The Spark Transmitter is a Two and One-Half K.W. Navy Type. The Radio Telephone Transmitter is a New Type Developed by Doron Bros. Electrical Co., With a Rating of One K.W. There Are Six U. V. 202 Radiotron, 5 Watt Transmitting Tubes in the Radiophone Circuit, 375 Volts Being Used on the Plates With 200 Milliamperes Input. The Filaments Burn on A. C. Supplied by a Step-Down Transformer. The Wave Length is 360 Meters. The Center Lead From the Antenna Goes Through a Thermo Radio Frequency Ammeter to the Set. This Meter Shows a Radiation of 2.8 to 3 Amperes. The Leads From the Ends of the Antenna Are Connected Through Meters Which Also Show a Reading of 2.8 to 3 Amperes. There is an Extra Lead Taken From the Inductance, Which Goes Through a Fourth Meter to the Ground. This Meter Shows an Additional Radiation of 1.25 Amperes. The Total Radiation is Secured by Adding All the Readings, Which Total About 10 Amperes. The Signals From This Station Have Been Heard in Every State in the U. S.; Also Alaska, Mexico, Panama and South America. The Great Range is Due Not Only to the Design But Also to the Fact That the Location is One Place in the Country Where Results Such as They Are Getting Would be Possible. The Ancient Ocean Bed and the Ancient Gulf Stream Crossed at This Particular Point, and There Are Rich Mineral Veins at a Depth of 3,200 Feet, Which Seem to Run Northeast to Southwest and Northwest to Southeast, Forming an X Which Lies Under the Entire Station. 5YL, Thibodeaux High School, Thibodeaux, La., Gives Dances to the Music From This Station and the Owners Would Like to Hear From Others Who Have Done the Same.

Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

Hook-up and Length of Aerial

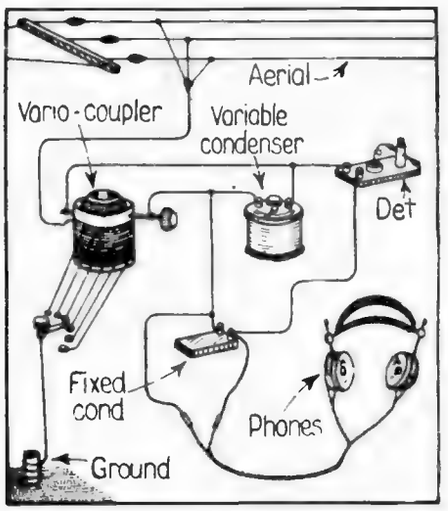
(47) Harvey M. Lawrence, Ariel, Pa., requests:

Q. 1. A hook-up for a vario-coupler, variable condenser, fixed condenser and crystal detector.

A. 1. We are giving herewith the hook-up as requested by you.

Q. 2. How far should I be able to receive broadcasts with this set and an aerial 270 feet long by 30 feet high?

A 2. We would advise you that your antenna is much too long for average broadcast reception, and we believe that you would obtain much better results if you cut the length down to about 100 feet, or not more than 150 feet. With such a set your consistent receiving range should be about 25 to 30 miles.



The Above Circuit Shows the Most Efficient Way in Which to Use a Vario-Coupler and Variable Condenser With a Crystal Detector, Phone Condenser and Phones.

Receiving WJZ in North Carolina

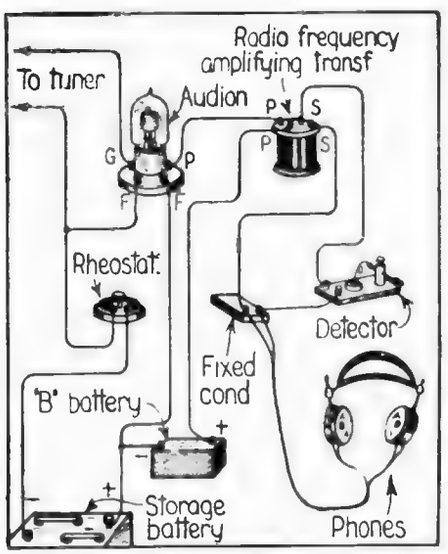
(48) Louis W. Baker, Raleigh, North Carolina, requests:

Q. 1. A circuit for amplifying the signals received by a crystal detector with an audion bulb.

A. 1. We are giving herewith a circuit diagram as requested. It is generally conceded however, that such a circuit as this will not give as satisfactory results as a single audion tube detector, due to the difficulty of keeping the same in adjustment.

Q. 2. Will I be able to receive WJZ with this combination, and if not what will be necessary to do so?

A. 2. Since you are approximately 425 miles from Newark, N. J., it will be necessary for you to use at least one step of radio frequency amplification, a detector and two steps of audio frequency amplification, in order to receive the broadcast from the latter satisfactorily.



A Circuit Diagram is Given Herewith, Showing How to Amplify Radio Signals at Radio Frequency, and Detect Them With a Crystal Detector. The "B" Battery Should Be 22½ Volts if a Detector Tube is Used for Amplification, or 45 to 60 Volts if an Amplifying Tube is Used.

Receiving Pittsburgh at New York City

(49) Raymond Ashworth, Jr., New York City, writes:

Q. 1. Give information on the cost, and, if possible, the construction of a radiophone receiving set which will receive from Pittsburgh, Pa.

A. 1. Of course, you realize that there is a great range in the prices of radio-telephone receiving outfits. A set with which you could hear Pittsburgh, Pa., would probably cost from $100.00 to $150.00, if bought already assembled. However, this could be provided much cheaper if you constructed it yourself. We would advise you to read the article entitled, "A Short Wave Regenerative Set," by William H. Grace, Jr., in the December, 1921, issue of this magazine. This set with an audion detector and two steps of amplification would undoubtedly receive the broadcast from Pittsburgh, Pa.

How to Adjust Your Set

(50) Fred Comstock, Pueblo, Colo., asks:

Q. 1. Give directions for manipulating the controls of a short wave regenerative receiver, using a vario-coupler and two variometers for tuning.

A. 1. We are giving you herewith general directions for tuning a regenerative set consisting of two variometers and a vario-coupler. Set the coupling between the primary and secondary of the vario-coupler at or near maximum, the detector filament at the proper brilliancy, which must be determined by experiment, and the primary tuning at or near its lowest value. Then, very slowly, vary the grid and plate variometers throughout their entire range. If signals are not heard, change the primary tuning one or two points, and go through the same procedure. This should be continued until signals are heard. If results are still not obtained, change the coupling a few degrees, and repeat.

After a signal is once located, adjust all controls for best results, remembering that if it is desired to obtain selectivity, that is, freedom from interference, the coupling must be kept as near zero as is possible without decreasing the signal strength. Make all adjustments in small steps, so as not to lose the signal at any time.

We believe that if you follow these directions in general you will have no trouble in obtaining the results desired.

Feature Articles in September "Radio News"

Broadcasting Methods. By Le Massena.

The Future of Radio. By Dr. Lee de Forest.

How to Make a Small Wavemeter. By Bernard Steinmetz.

A Honeycomb Coil Receiver and Amplifier. By Hoyoux.

The Cohen Static Eliminator. By S. R. Winters.

Armstrong Super-Regenerative Set

(51) Harold N. Bliss, Ithaca, N. Y., asks:

Q. 1. Are the Armstrong Super-Regenerative sets really efficient and worth while?

A. 1. We would suggest that the Armstrong super-regenerative circuits are not meant for the average amateur to work with, inasmuch as they require a fairly good knowledge of the working of radio instruments as well as unlimited patience in adjusting the same. The circuits are extremely critical, and we do not believe that the average amateur would be satisfied with the results obtained when using these circuits in their present form.

Q. 2. Please give data for a 10 milli-henry air core inductance coil.

A. 2. For a 10 milli-henry air core inductance coil we would advise you to wind 380 turns of No. 22 S. S. C. wire in one layer on a core 5 inches in diameter.

Q. 3. Please give data for a 100 milli-henry iron core inductance coil.

A. 3. The secondary of a ¼-inch spark coil with an iron core inserted therein will give an inductance of approximately 100 milli-henries.

Spider Web Coils

(52) Alex C. Herro, Oconomowoc, Wis., asks:

Q. 1. How to wind three spider-web coils to use to tune to 600 meters.

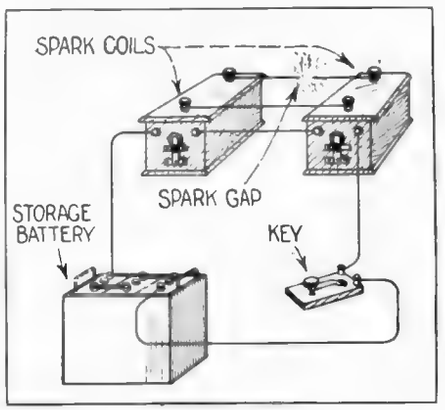
A. 1. The discs used are 3½" to 4" in diameter with 17 slots cut in each. The center radius—that is, the distance from the center of the disc to the lower end of the slots—should be ¾ of an inch. Wind one with 60 turns of No. 24 S. S. C. wire for the primary; one with 50 turns of the same size wire for the secondary; and the last one with 35 turns of the same size wire for the tickler.

Connecting Two Spark Coils Together

(53) Henry T. Becker, Florin, Pa., inquires:

Q. 1. How to hook up two spark coils so as to obtain a spark equal to the sum of the spark lengths of both coils.

A. 1. To use two spark coils together, connect the primaries in series with each other, and the secondaries in series with each other. Only one vibrator is used with the two coils, and the other should be tightened so that it cannot move. The one used should be equipped with extra heavy contacts in order to handle the higher voltage which must be used to obtain satisfactory results. For two one-half inch spark coils, use six to nine volts.



In Order to Obtain a Spark of the Same Length as the Sum of the Spark Lengths of Two Spark Coils, Connect Them as Shown Above.

Buried Antennae

(54) O. C. Ledbetter, Burbank, Cal., writes:

Q. 1. Give me some information on loop and underground aerials.

A. 1. The underground antenna works best if a well insulated wire is buried beneath the surface of the earth, stretching out in four or eight directions. This antenna is particularly suitable for reception in locations where the static is very heavy.

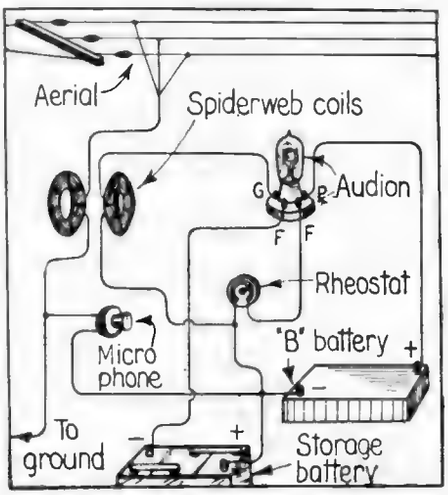
With loop antennae the same holds true. The loop is very directional, although subject to static effects to a greater extent than the underground antennae. Both of these types require audions for for their proper operation. A third style is the ordinary loop antenna buried underground, and free to swing in any direction desired. This is probably the most efficient of all.

Five-Watt Transmitter

(55) J. H. Wooley, Kansas City, Mo., asks:

Q. 1. Please give circuit diagram for a simple 5-watt radiophone transmitter.

A. 1. We are giving a diagram herewith.



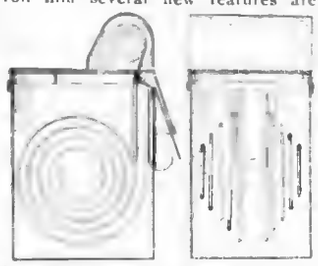
We Give Herewith a Circuit Diagram of a Low Power Radiophone Transmitter Which Was Submitted to Us by Harold B. Graham of Spring Valley, N. Y. For Tuning He Used Two Spider-Web Coils, Each Wound With 30 Feet of No. 22 S.S.C. Wire. The Tube Used Was a V.T.2 With 130 Volts on the Plate. His Aerial Was 60 Feet Long and 35 Feet High. He Claims a Range of 15 Miles With Perfect Modulation and Very Sharp Wave. If a 5 Watt Power Tube is Used, Use About 300 to 350 Volts on the Plate. Try the Circuit, Brother Experimenters, and Let Us Know What Results You Obtain.

LATEST PATENTS

Film Developing Device

(No. 1,414,769, issued to George C. Beidler)

In this device for developing roll film several new features are

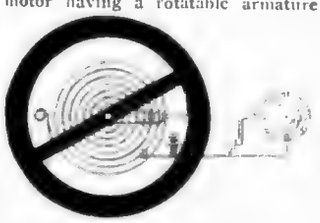


found. An ordinary square tank with a suitable cover and a housing to hold the roll of film is fitted with a coiled wire form. Two of these coils, one on either side, are used in the completed apparatus. These coils are arranged so that the separate turns are placed out of line with each other. This prevents undue contacting of the film with the holder at any given point. The roll of film is first put into the housing where it is secured in place; the black backing paper of the roll is then drawn out through the side of the box, as illustrated in the accompanying diagram. The film itself will be guided downward into the spiral-like coil by simply pulling on the backing paper to which it is attached.

Electric Clock

(No. 1,408,274, issued to Leo Dorfman)

In this electric clock an electric motor having a rotatable armature

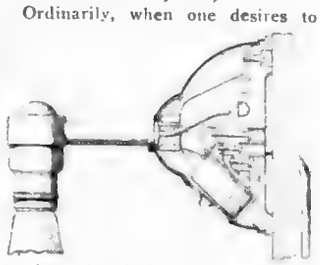


and an escapement device is employed. The escapement member itself is so arranged that as it oscillates back and forth, the escapement wheel is turned. Attached to the escapement wheel is a ratchet wheel which communicates with a spring. This ratchet wheel flexes or releases the spring just mentioned. To the spring a ratchet communicating with a similar hook on the escapement member assists to actuate that member. Sufficient energy is thus periodically stored in the energy-storing spring to compensate for frictional losses during each cycle of the oscillation.

Combination Electric Light Fixture

(No. 1,404,732, issued to Reuben B. Benjamin)

Ordinarily, when one desires to

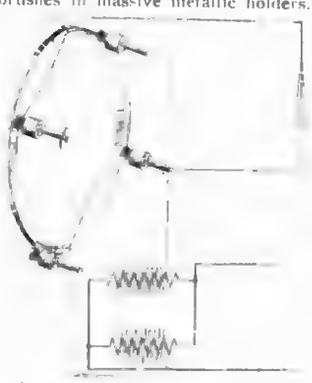


employ electrical appliances, such as flat irons, toasters, etc., a lamp must be removed from the fixture, and the cord be inserted into the lamp socket. Consequently, it has frequently been desirable to use wall sockets for this purpose. In this device an additional socket is connected within the shell of the fixture. This socket is so arranged that when the plug is not in the current tap socket, the center contact to the plug is disconnected from the circuit, and the socket is dead.

X-Ray Machine

(No. 1,409,439, issued to Charles Fayer)

This is an improved system for rectifying current for X-ray machines which reduces sparking at the brushes, and performs various other operations. In the diagram a transformer with the primary and secondary windings is shown. Connected to the secondary wires are brushes in massive metallic holders.



and two other such brushes are connected to the terminals of the spark gap. A disc of homogeneous form is connected to a motor which rotates at a speed of about 1800 revolutions per minute. On this are four contact sectors, the pairs being connected by two wires. The parts are so arranged that as the disc rotates, the revolving contact sectors engage the brushes when the potential in the secondary circuit is at its maximum

Salvage Vessel

(No. 1,413,413, issued to John F Lukomke)

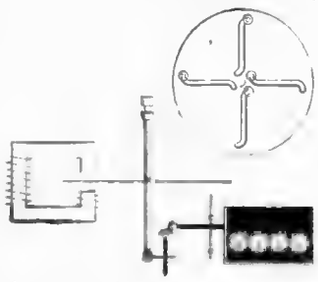
This salvage vessel consists of a large frame upon which are mounted approximately seven sets of cylinders. These cylinders are equipped with moving pistons, operated from the cabin of the vessel, through the agency of cables. These cables are connected to spindles, which may be manually or electrically operated.

Diving bells are also attached to this floating salvaging vessel for the operators. The device is floated out or moves out into the water by its own power, being equipped with gasoline engines for this purpose when afloat and electrical motors and storage batteries for submerged use. By permitting the pistons of the pumps to travel toward the closed end of the piston, the air within the pumps is compressed, or released into the surrounding water, and the water takes its place. It is evident that the buoyancy of the vessel has now been materially decreased, and the vessel sinks. The inventor believes that with this device he would be able to carry on considerable work below the surface of the seas. We are of the opinion, however, that operation in one of these is as limited as it would be in a converted submarine.

Electrical Measuring Instrument

(No. 1,408,119, issued to John Harold Miller)

Here is an extremely simple watt-hour meter which will indicate only

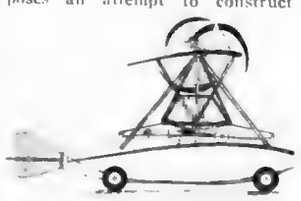


the energy in excess of a predetermined power demand. It comprises a magnetized core with an armature shaft and integrating mechanism. A torque opposing device is mounted on a shaft driven by the meter. This is a disc in which a number of Z-shaped slots are found. The middle or body portions of the Z-shaped slots are disposed radially and the inner and outer portions are bent laterally. In operation weights in these slots fall from the periphery of the disc toward the center, and in doing so, the weights at the periphery having longer radii oppose the action of the meter while those nearest the center assist its movement

Flying Machine

(No. 1,417,602, issued to August P. Hedberg)

In this device, the inventor proposes an attempt to construct a

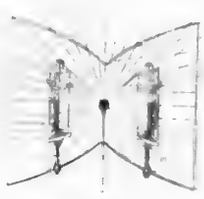


flying machine of the paddle-wheel type, which theoretically, at least according to his claims, will hover over a point, or rise vertically whenever desired. The lifting and propelling mechanism is placed over the body of the machine. A drum with wing-like devices attached thereto is rotated by means of a gasoline motor thru gears. A cam like device regulates the collapsing of the winged structures, so that they may be made to open or fold at any point desired. The rotary plates are free to rock and engage the air as the entire drum rotates.

Aerial Signal Light

(1,413,379, issued to Henri Luglien M. J. Bernard)

In this invention which aims to provide for a searchlight producing a continuous horizontal beam of light in two directions, and also a vertical beam extending from the horizon to the zenith of the search-

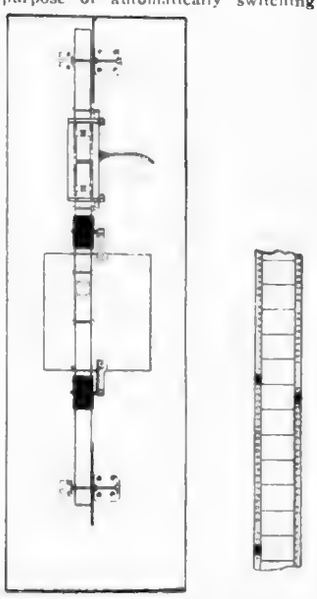


light, slotted lenses are made use of. At either end of the searchlight we find the lenses mounted upon U-shaped holders. In the center is the lamp itself, in this instance indicated by a mantle burner. Then, if we assume that one had taken a saw and cut his way through the top of the searchlight housing, as well as the lenses, until the center of the lens was reached, we will form quite a clear conception of the slotted effect presented by the device.

Printing of Photographic Films

(No. 1,413,598, issued to Henry V. Lawley)

In the printing of photographic films by what is known as the automatic printer, drums are often employed on which are pegged contacts. These contacts are for the purpose of automatically switching

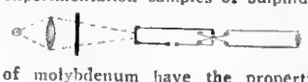


in lights of predetermined printing power, so that the final positive is fairly constant in density. The pegs in this device are set manually. In the present invention metallic contacts are hooked into the sides or edges of the film and are used as contacts for automatically switching in a greater or lesser amount of light. These contacts are hooked into position upon the film during its initial inspection, similar to paper clips and nothing remains for the printing operator to do except permit the film to pass thru the machines.

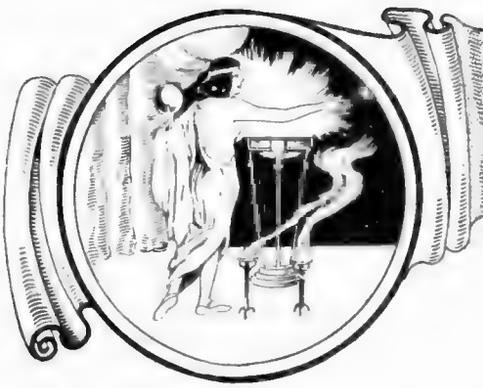
Electrical Resistance

(No. 1,418,362, issued to William W. Coblentz)

Mr. Coblentz has found that in experimentation samples of sulphide



of molybdenum have the property of undergoing a change in electrical resistance when exposed to the action of light, and when a suitable voltage is applied to the terminals of the crystal, and the same exposed to the light particularly certain wave lengths of light, less than .65 micro-millimeters in length, the resistance of the crystal in the circuit is decreased. The molybdenum sulphide may be soldered directly to copper wires without electro-plating it by using ordinary solder. In the outline of the circuit there is shown a source of light, a lens and transparent color screen, such as ruby-glass, and a second color screen, not shown in the illustration, adapted to be substituted for the lens.



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

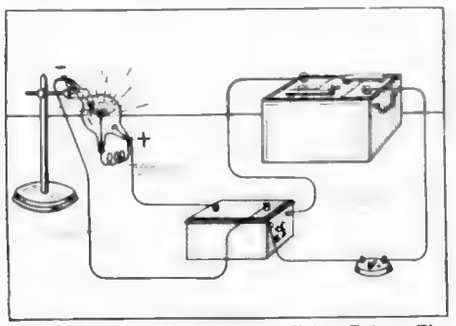
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

X-RAYS

(1280) James Brownley, Chicago, Ill., asks the Oracle:

Q. 1. How to hook up an X-ray tube, showing all the instruments necessary.

A. 1. We are giving the circuit requested herewith. The direction of the X-rays is shown in dotted lines.



Above Is Shown a Hook-up for An X-Ray Tube. The X-Rays Emanate in the Directions Shown by the Dotted Lines.

Q. 2. Are objects receiving X-rays visible to the naked eye, or must some special apparatus be used in order to see them?

A. 2. X-rays do not make objects visible to the human eye, and to see the effects of them it is necessary to interpose a special screen between the eyes and the object through which the X-rays are to penetrate. The cardboard screen is coated with a flourescent substance, such as barium-platinum-cyanide, or calcium tungstate. This screen is best placed in one end of a black wooden or pasteboard box, against the other end of which the eyes are placed when in use.

This screen under the influence of X-rays becomes luminous and enables one to see shadows or silhouettes of objects of denser material interposed between the eyes and the X-ray tube, when the tube is in operation.

SKY-ROCKETS

(1281) Louis A. Fortin, Esq., San Francisco, Cal., writes:

Q. 1. How are sky-rockets made?

A. 1. For rockets, we would advise the following:

Sulphur	1 part
Wood charcoal	2 parts
Nitre	4 parts
Meal Powder	1 part

(This powder is a black or brownish colored dust.)

The material is placed in long heavy cardboard tubes closed at both ends in the conventional manner.

Another form consists of:

Sulphur	4 parts
Carbon	3 parts
Nitre	8 parts

This gives out a shower of sparks. The fuse to go with either is merely gun powder wrapped loosely in tissue paper.

We would advise that you experiment with the above mentioned items, but at all events exert great caution in mixing the ingredients, all of which should be in the powdered state before mixing and the mixing itself should be done with a wooden spatula so that friction is minimized.

GAS MASK CHEMICALS

(1282) W. Feller, Pittsburgh, Pa., requests:

Q. 1. Information on the chemicals used in gas masks.

A. 1. The material used for filtering the gas in the American gas masks generally consists of charcoal made from peach pits. The French use a pad of cotton saturated with lime water through which air was breathed in, and also through which the exhaled air passed out. In this way they differ from the American gas masks, in that, in the latter, the air is breathed through the charcoal, and when the breather exhales, valves automatically pass the exhaled air out, without permitting it to pass through the charcoal. In this way, the charcoal is kept free from carbon dioxide and other impurities exhaled by the wearer of the gas mask.

THE VACUUM BOTTLE

(1283) H. S. Leventhal, Melrose Park, Ill., asks:

Q. 1. Why are the interior walls of the container in a vacuum or thermos bottle silvered in much the same manner as is a mirror.

A. 1. While the glass and the vacuum can stop the conduction of heat, still they cannot stop the heat from radiating into or out of the bottle. This, however, is stopped by the silver surfaces, as they are smooth and shiny. Thus any heat trying to radiate into the bottle is reflected out again, and any heat trying to radiate out is reflected back again.

Q. 2. Does the size of the space between the walls of the container effect the efficiency of the same?

A. 2. Of course, up to a certain extent which, however, is limited by convenience, and considerations of size, the space between the walls of a vacuum container will have an effect on the heat or cold retaining qualities of the bottle. The wider the space, the higher the efficiency.

MOON'S INFLUENCE ON VEGETATION

(1284) Wm. F. Justin, Mt. Clemens, Mich., asks:

Q. 1. Has the moon any influence on the rise and fall of sap in vegetation and trees.

A. 1. Although we do not believe the moon has any influence on vegetation, particularly not with regard to the flow of sap in trees, many farmers in this and other countries are of the opinion that such moon's influence is a positive fact. Actual experiments on plants and animals show very little effect by the moon upon any of earthly bound things, with the exception of the tides.

Interesting Articles in August "Practical Electrics"

The Loud Speaking Telephone and Distance Transmission of the Voice.

Home-made X-Ray Screens.
By Raymond B. Wailes.

Automatic Train Control.
By Frank R. Sprague.

New Air Depolarizing Battery.

Great Electric Advertising Sign.

Electric Resonance.

HEATING A TUNGSTEN FILAMENT IN THE OPEN AIR

(1285) Geo. W. Brenker, Brooklyn, N. Y., wants to know:

Q. 1. What would happen if the tungsten filament of an electric light bulb was allowed to become incandescent in the open air instead of in a vacuum?

A. 1. The tungsten filament, if allowed to burn in air, will immediately oxidize and be completely destroyed, or at least destroyed sufficiently to prevent current passing through.

SELENIUM CELLS

(1286) Fred E. Baack, Los Angeles, Calif., wants to know:

Q. 1. How long selenium cells keep their sensitiveness

A. 1. The period of life of a selenium cell is from six months to two years.

Q. 2. What voltage and amperage should be used with the above?

A. 2. The amperage passing through these cells is extremely low and the E M F applied is usually 12 to 20 volts.

Q. 3. How much light is necessary to operate a selenium cell?

A. 3. A one candle-power light is sufficient to set them in operation and it does not make any difference whether it is direct or indirect light.

The resistance of the cell varies inversely as the intensity of the light, and, although it loses its resistance almost instantaneously upon being exposed to light, it comes back to normal rather sluggishly.

AIR-PROPELLED VEHICLES ON PUBLIC STREETS

(1287) Virgil Beckman, Salisbury, Mass., asks:

Q. 1. Is there any law which will prevent me from operating a vehicle propelled by an air propeller on a public street?

A. 1. We do not see any reason for not allowing air-propelled vehicles to travel through city streets. In view of the fact that these are being used in San Francisco, Chicago, and other large western cities, we would hold that there is no restriction against them.

At the present time no law to this effect has been enacted. Nevertheless, just as a matter of precaution, we would advise that you place a guard around the propeller to prevent accidental decapitation. A motor vehicle license is necessary.

½ KILOWATT LOW VOLTAGE TRANSFORMER

(1288) T. K. Albright, North Greece, N. Y., requests:

Q. 1. Data on a ½ K. W. transformer, giving secondary voltages of from 2 to 50 volts in small steps.

A. 1. We believe that you are going to have some trouble in constructing a ½ K. W. transformer that will give as low a voltage as two volts on the secondary, inasmuch as 500 watts at two volts means an amperage of 250. However, we are giving you herewith specifications as requested.

Build up a core of laminated iron strips, 1.4 inch wide into a rectangular form 14 inches long by 7 inches wide, with sides 1.8 inch high.

Wind the primary with 480 turns of No. 13 D. C. C. wire in four layers. This will require six pounds of wire.

Begin the secondary winding with No. 000 D. C. C. wire, and wind 66 turns of this size, taking off taps at the following turns: 9th, 18th, 27th, 36th, 45th, 54th, 66th. These taps will give you the following voltages respectively: 2, 4, 6, 8, 10, 12 and 15. Now solder the 66th turn to No. 1 D. C. C. wire and wind until the total number of turns in the secondary is 220. During the winding, take off taps, counting from the beginning of the secondary winding, at the 88th, 132d, 154th, 176th and 220th. These taps will give you respectively 20, 30, 35, 40 and 50 volts.

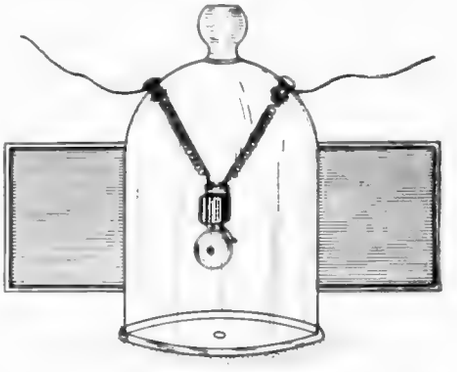
SOUND IN A VACUUM

(1289) Walter Bennett, Freehold, N. Y., asks:

Q. 1. Will a vacuum allow transmission of sound? If not, can you give some simple experiment to prove that it will not?

A. 1. A vacuum will not allow transmission of sound through it. This may be proved by supporting an electric bell on a felt cushion, or by elastic suspension under the glass receiver of an air pump. This suspension is to prevent the bell communicating its vibrations to the glass walls of the receiver. Connect the bell through an external circuit to a battery. A method of suspending the bell in the receiver is shown herewith.

As the air is exhausted from the receiver, the sound of the bell becomes fainter, and when a good vacuum is reached, it is nearly, if not altogether, inaudible. As air is re-admitted, the sound grows louder, and regains its full intensity when the air—i.e., the transmitting medium—is completely restored.



The Above Cut Illustrates An Experiment Which Shows That Sound Is Not Conducted by a Vacuum.

THE ELECTROPHOROUS

(1290) Harry Gordon, Bayshore, L. I., N. Y., inquires:

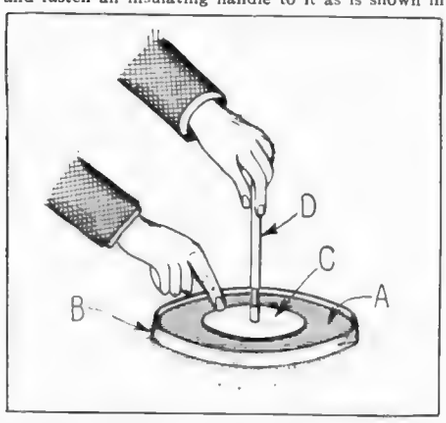
Q. 1. What is an electrophorous?

A. 1. An electrophorous is an instrument for generating static electricity.

Q. 2. How can I make one?

A. 2. Obtain a brass dish about 8 inches in diameter by about ½ inch deep, fill it with molten rosin, and allow it to cool.

Obtain a flat brass disc about 6 inches in diameter, and fasten an insulating handle to it as is shown in



Herewith Is Shown the Construction and Operation of An Electrophorous. "A" Is a Cake of Rosin; "B" a Brass Dish or Container for "A"; "C" a Brass Disc, and "D" a Handle Insulated from "C".

the accompanying cut. The method of fastening this handle should not allow a bolt or screw head to project through the lower side of the disc, but the handle should be fastened with solder or glue. A very good way of doing this is to solder a brass rod to the plate and either tape this thoroughly or cover it with a glass tube which fits it snugly. Shellac may be used to fasten the glass tube to the brass rod.

Q. 3. How is this instrument used?

A. 3. Rub the cake of rosin (A) with a dry flannel or piece of cat fur briskly for several seconds. Then place the metal disc upon it. Touch the cover momentarily with the finger, and then remove it and remove the disc from the cake by means of the insulating handle, (D). It will be found that a spark may now be drawn from the cover by presenting the finger or knuckle in proximity to the same. This operation may be repeated an indefinite number of times.

STEAM BOILER

(1291) H. Chappell, Sandy Lake, Pa., inquires:

Q. 1. What pressure could be attained in a steam boiler made from an ordinary ten-gallon milk can with all seams soldered and riveted?

A. 1. The maximum working pressure of a steam boiler such as you describe, could vary anywhere from 10 pounds per square inch, to 50 pounds. This depends entirely on the thickness of the metal, rivets, etc. We would advise that in constructing a steam boiler, you place a gauge upon the device, raise the pressure to about 10 per cent above what you expect to carry, and test it out in the open field. If anything happens, of course you will not be injured, inasmuch as you will be quite far away. The boiler will then be safe to operate indoors.

REWINDING A GENERATOR

(1292) J. F. Applewhite, Laredo, Texas, asks:

Q. 1. How to rewind a 6-volt automobile starter-generator to deliver 32 volts.

A. 1. Inasmuch as you have not given us sufficient definite information regarding the 6-volt starter-generator, we would advise that you calculate size wire yourself. Rewind both the armature and field so that the resistance is equal to 5½ times the resistance of the wire now employed.

You can determine this by removing wire and measuring its length. Then measure its size and refer to any wire table for the resistance per foot of that size wire and multiply by that number of feet to obtain the total resistance. Then multiply this by 5½ in order to obtain the figure for the total resistance of wire for a 32-volt machine. By simply reversing the process then you can determine the size and the number of feet of wire necessary for rewinding the generator.

CONTROLLING A MOTOR WITH A MICROPHONE

(1293) Baldwin Alexander, Washington, D. C., wants to know:

Q. 1. If it would be possible to control the speed of a motor by inserting a microphone in one of the motor leads and talking into it?

A. 1. The resistance in a microphone circuit is so great that not enough current could possibly find its way to the armature of a motor in order to make it rotate. For this reason your motor will not be able to operate in synchronism with the compression or decompression of the carbon grains, unless a small current, say a fraction of an ampere, passes through the microphone, such as the field current of a small machine.

DENSE SMOKE IN MOVIES

(1294) Paul Hodges, Tuscumbia, Ala., asks:

Q. 1. How is dense smoke produced in the movies?

A. 1. The dense smoke which is used in the Navy for smoke screens is made by burning fuel-oil with insufficient air. The product is very disagreeable and should not be used indoors.

Q. 2. What is Quininum ruber?

A. 2. Quininum ruber is otherwise known as Cinchona bark. This is red Cinchona bark, and comes from Lox and other parts of Ecuador. It is also cultivated to a certain extent in India. Its uses are medicinal.

Q. 3. How can I make Pharaoh's serpent eggs for pyrotechnic displays?

A. 3. Pharaoh's serpent eggs are made as follows: Take mercury and dissolve it in moderately diluted nitric acid, applying heat at the same time. Take care, however, that there be always an excess of metallic mercury remaining. Decant the solution and pour it in a solution of sulphocyanide of ammonium or potassium, which may be bought at a good drug store or from a dealer in chemicals. Equal weights of both will answer. A precipitate will fall to the bottom of the beaker or jar, which is collected on a filter paper and washed two or three times with water, when it is put in a warm place to dry. Take for every pound of this material 1 ounce of gum tragacanth which has been soaked in hot water. When the gum is completely softened it is to be transferred to a mortar, and the pulverized and dried precipitate gradually mixed with it by means of a little water. From the resulting mass, pellets of the desired size are formed, put on a piece of glass, and dried again. They are then ready for use.

MOTOR TO RUN GENERATOR

(1295) John A. Cooper, Jeffrey, W. Va., asks:

Q. 1. What horse-power motor will be necessary to run a generator giving 440 volts at 24 amperes?

A. 1. The horse-power rating will have to be about 15, provided that the generator is correctly designed. To be on the safe side, we would advise a 20 horse-power motor, especially if belt drive is to be used.

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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FREE ENERGY

(1296) Charles Forner, Gainesville, Fla., wants to know:

Q. 1. If the heat present in the air could be utilized for power? If so, this should give practically free energy.

A. 1. When you stated that you thought it would be a good idea to build a machine which would absorb some of the heat of the atmosphere and transform it into energy, you had not made a very new statement. As a matter of fact, about fourteen years ago, a clock appeared on the American market called "The Perpetual Clock," which derived its power from the changes in atmospheric temperature.

Q. 2. Is radium not merely transformed atmospheric energy?

A. 2. Radium does give out an immense amount of energy, but do not forget that all of that energy and even more has been stored into it in the process of forming the same. This energy is not transformed atmospheric energy in any way, it being proven greater than atmospheric energy when delivered in a vacuous chamber or in places otherwise sealed against atmospheric or other effects.

Q. 3. How does Einstein explain that a brick is shortened in proportion to its speed as it travels through space? I should think that in absolute space a body would have no motion.

A. 3. When you get down to Einstein's theory, you are immediately running into deep water. There are many incredible assertions made by Einstein which are not up to the present time definitely proven. Much of it is theory; as a matter of fact the entire system is theory, and your theory may be just as correct as his, except that he has made scientific deductions in an attempt to prove that his theory is correct, and you possibly cannot make those investigations. We would advise that you read up the various books and articles appearing on the Einstein theory, as, for instance, "The Einstein Theory," by Lorenz, and "Easy Lessons in Einstein," by Slosson.

REMOVING TREE STUMPS CHEMICALLY

(1297) Geo. Berkemeier, Covington, Ky., says: That he has a formula for removing stumps by causing them to decay chemically and wants to know:

Q. 1. If we think it will work.

A. 1. There is, perhaps, a solution which will do as you claim, but we doubt it, and unless you have absolutely tried it out, and know that such a thing is true, we would view this idea with suspicion.

There is only one method which we know of to accomplish this work, and this is as follows: Dissolve some potassium nitrate in water, and pour into holes drilled into the tree stump. This is preferably done in the early fall, and from time to time additional quantities of liquid are added. This thoroughly permeates the stump, and in the spring the stump may be set on fire, and it will be found to burn down into the very roots.

DISSOLVING AMBER

(1298) J. H. Abernethy, Portsmouth, Va., wants to know:

Q. 1. How can amber be dissolved or brought to a liquid state?

A. 1. The amber is first bleached by placing a quantity of yellow amber in an earthenware crucible, adding twice as much rock salt by weight and pouring in it as much spring water as will dissolve the salt. When the latter is dissolved, more water is added, and the crucible is placed over a fire until the color of the amber is changed to a perfect white. The bleached amber is then placed in an iron pot, and heated over a common fire until it is completely dissolved, after which the melting pot is removed from the fire, and when sufficiently cool, the amber is taken from the pot and immersed in spring water to eliminate the salt, after which the amber is put back into the pot and again heated over the fire until it dissolves.

MOLDING COPPER

(1299) J. Bartlett, E. Toronto, Canada, requests:

Q. 1. A formula for softening copper so that it can be kneaded to any required form.

A. 1. There is no way in which copper can be made soft, so that it can be molded into any desired shape, chemically. Copper can be deposited upon a mold electrolytically and will come out in the desired shape, or it can be poured into a mold when in a molten state, and come out in this form. It is not moldable, however.

EFFECTS OF COLORED GLASS ON VISION

(1300) J. J. Curran, Waseca, Minn., asks:

Q. 1. Is it possible to neutralize the effect of looking through a colored glass, by adding another glass of a different color?

A. 1. In looking through a ruby-colored glass, it is possible to perceive only those colors which are allowed to pass through this glass now acting as a filter. In other words, your eye will perceive only ruby color and no object so colored.

By adding glass of a different color, instead of increasing the ability to see, you cut down the small number of those few rays which have been able to pass through the first filter. On rare occasions, two glasses are used in order to obtain a pure color; that is a blue and a yellow glass might be used together to filter out green.

THE POWER OF SPRINGS

(1301) Samuel Chaber, Brooklyn, N. Y., asks:

Q. 1. Is it possible for a wound-up spring, while unwinding, to wind up another spring of equal power, with the aid of a fly-wheel?

A. 1. It is not possible for a wound spring to wind up another spring of equal power and strength, even though a fly-wheel is used. The inertia will wind up the second spring but not fully, and if both are connected together, they will continue to oscillate for a short period of time, whereupon the oscillations will gradually die down and finally cease.

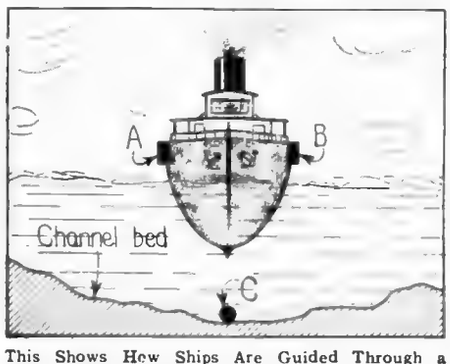
SHIPS GUIDED BY ELECTRICITY

(1302) John Breen, Bridgeport, Conn., inquires:

Q. 1. Is there any way for ships to come into New York Harbor safely during a heavy fog?

A. 1. Ships may now successfully pass into and out of New York Harbor in spite of fogs.

The method of signaling is by means of two exploring coils mounted upon the ship, as shown herewith, communicating with a pair of telephonic receivers worn by the pilot. A cable carrying alternating current is at the bottom of the channel so that an induced current affects both coils upon the ship. The different intensity of sounds heard in the ear phones enables the pilot to tell whether he is to the right or left of the cable, or right over it.



This Shows How Ships Are Guided Through a Channel By Means of Electricity. "A" and "B" Are Coils Mounted on the Sides of the Ship, and "C" Is a Cable Carrying Alternating Current. The Action Is Explained in the Answer to Question.

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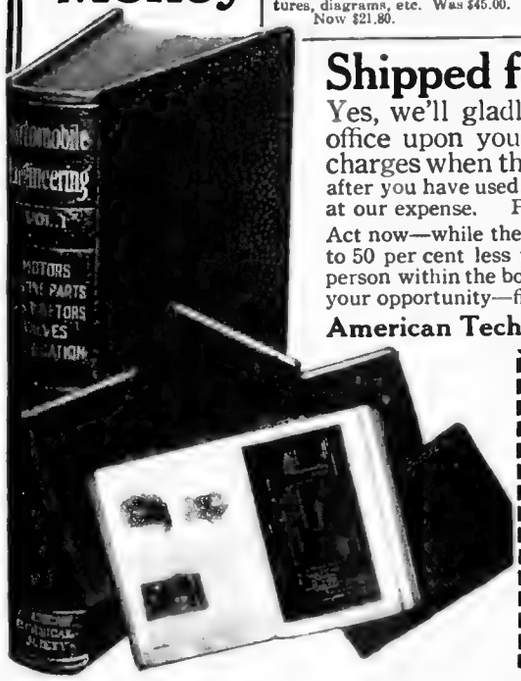

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"I want to congratulate you, young man, on the marks you are making with the I. C. S. I am glad to see that you are training yourself not only for your present job but for the job ahead.

"We're cutting the pay-roll. Until I received this letter, I had you in mind as one of the men to be dropped. But not now. Keep on studying—keep your eyes open—and pretty soon there'll be a still better job for you around here. We're always looking for trained men."

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How Experts Identify Discharged Bullets

(*Continued from page 431*)

arrangement is adopted like that used in photographing sections of steel, illuminating these striations in the direction of the axis of the objective.

Generally, microphotography follows the ocular examination through the microscope, and comes next on the judiciary report. It is done by the use of the Nachet camera, which is adjusted by two vertical supports, so to be set at variable heights. The microscope is placed on a table forming the base of the apparatus, and is attached by removable clamps to the latter. In this way the object can be lighted, the camera being separated from the microscope.

But it sometimes happens that the microscopic or microphotographic examinations carried out do not disclose whether the ball in question was fired from the particular pistol under consideration. To do away with all doubts, the developed surfaces of each ball are brought side by side, so as to determine the coincidences or differences in the markings. In the judiciary laboratory they work after two methods.

In the first method, using the proper disposition and a very long focus lens, they photograph upon the same plate and with a magnification of ten to twenty diameters, the two balls to be compared. The two balls are placed base to base and the scratches are compared one by one.

The second process is entirely mechanical. It consists in taking an impression of the surface of the ball, pressing this strongly on a plate of plastic material, and rolling it around on its side. As a substance to receive the imprint, tinfoil is employed.

With such a diagram micrometric measurements can be made and conclusions can be reached by juxtaposition. Sometimes the impressions thus made are photographed.

Now let us go back to the affair of the Marseilles Express to see how M. Bayle managed to identify the cartridge shells. The articles placed at his disposition under seal of the court included: an "automatic pistol No. 44056," with a clip belonging to a man named Thomas, an automatic "Alld-daza ball" with two clips, and another revolver "St.-Etienne," 7 mm. 65, both found upon the bandit Bertrand, finally a revolver No. 6675 taken from the principal accused robber, Charrier. On the other hand, a brass cartridge shell was found marked F. N., 8.5 mm. diameter, in the car number 489 of the train number 5, and the judge ordered the expert to find from which of the pistols the cartridge shell had been ejected.

The learned specialist solved his problem in the following way.

With each of the four pistols in the case, he discharged three cartridges of the F. N. mark, and collected the twelve ejected shells to compare it with the shell in the case. The immediate examination of the effects of the discharge, served to identify the pistol No. 6675 (Charrier), as being from the St.-Etienne factory, as they carried *eccentric* faces and those of three others were centered. The three kinds of cartridges were passed successively under a microscope showing the erosion produced by the ejector, and the central indentation on each one. The conclusion was reached, that the shell found in the first class car of train No. 5, came from a cartridge discharged from the revolver No. 2032 belonging to the assassin, Bertrand.

But outside of the identification of the balls and cartridge shells, the court has often to know the character of the wound at the entrance and exit of the projectile, through the skin of the victim, as well as the paths of the balls through the principal organs of the body. Certain observations help the experts with their task. Thus, a shot at a very short distance makes an aureole of variable form and color on the skin of the corpse; the aspect of the puncture and the effect in the vicinity of the wound vary with the nature of the powder and the composition of the ball, with the distance of the victim, the kind of arm used, the direction of the shot, the surroundings of the body, etc. These minor details are valuable for elucidating the circumstances of the crime, and for distinguishing black powder from smokeless powder. For example, in the case of wounds from automatic pistols at short range, fragments of square plates of plumbago surround the wound. These are ordinarily found in such cartridges. In a recent case, the court's physician examining the vicinity of the hole made by the ball in the vest of the person found dead, proved that he was not accidentally killed by an automatic pistol, as those with him pretended. Microscopic particles of black powder gathered around the superficial markings observed, proved that the poor fellow had been shot with a revolver. Finally, if the ball is missing from the records of the court, a skillful technician can sometimes penetrate the mystery.

Flowers Everlasting

(*Continued from page 429*)

but they must be perfectly dry. Good results are obtained with those flowers which have just opened, are perfect in form and possess bright colors.

Twigs and sprays of pine and fir are often used for decorative purposes, especially for some corner or other. Here they are very effective when placed in a vase. This is especially true of the fiery colored autumn foliage of the hardwoods. To prevent the falling off and discoloration of the leaves or needles, a simple expedient can be employed. The cut end of the twigs is sealed with sealing wax as soon as cut so that the sap cannot exude. Then they are placed flat upon the table and the leaves or needles, together with the twigs, are vigorously rubbed with a mixture of one part of glycerine and one part of water. Both sides of the leaves are to be treated in this way. Then they are allowed to remain for a while to dry superficially. Finally they are placed in the vase. Although foliage prepared in this way keeps its freshness for a long time, it is by no means as enduring as the everlasting flowers.

Delicate moss-like structures suspended in shells of various kinds can sometimes be seen in the different stores. This "sea moss" will last for years, requires no moisture and will not fade or discolor. It requires absolutely no care and this, for the simple reason that it is not a plant, but a colony of dead animals. These hydroid polyps are tiny creatures, living in the waters along the beach. They develop numerous branched feathery projections consisting of a chitin like substance in which the individual, sessile animals are found. These bunches form thick clusters in the shallower places, whence they are fished out. Then they are thoroughly dried and, after drying, they become a product of commerce.

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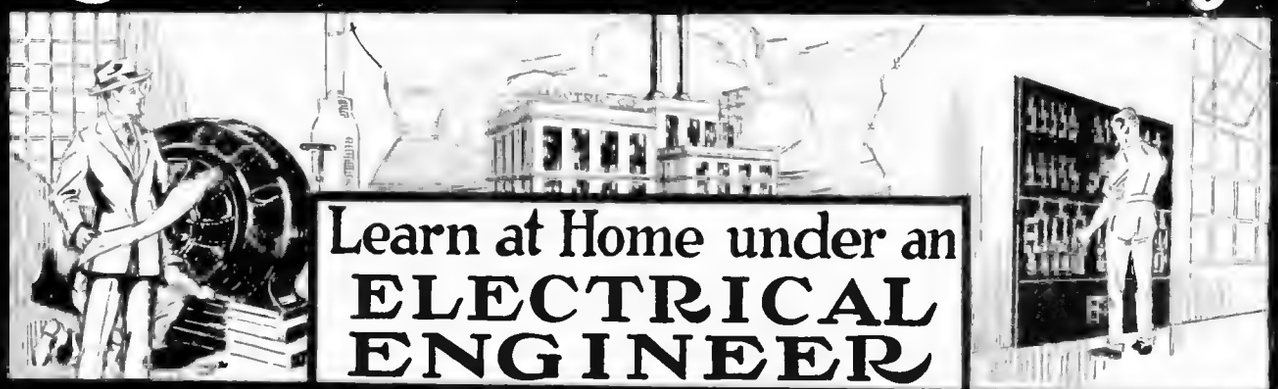

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Sound Wave Measures Ocean Depths

By H. WINFIELD SECOR

(*Continued from page* 430)

ly, depending upon how the scale is calibrated, is shown in the smaller illustration herewith. Here a drum driven by clock-work and cord is caused to move a delicately balanced needle across a scale, as indicated in the illustration. This clock-work is fitted with two electro-magnet releases, one for starting the clock-work when the transmitting key is depressed; and the second magnet to stop the clock-work when the reflected sound wave is received by the microphone. The action of this instrument is as follows: At the instant the sound wave transmitting key is depressed, the needle starts moving slowly over the scale. When the sound wave is received, the cut-off electro-magnet operates, and the needle is stopped in its passage across the scale. This scale of this instrument is, of course, calibrated in such a way that the total elapsed time is allowed for, as aforementioned, this time period being twice that required for the sound wave to reach the ocean bottom. After the reading has been taken, the needle is returned to zero again.

The great and all-important feature of the new deep sea-sounding apparatus is that soundings can be taken rapidly and without dropping any lines or weights, and also while the vessel is in motion.

The new device was tried out on a cruise of the U. S. destroyer *Stewart* from Newport and Gibraltar and proved a complete success, registering automatically and instantaneously depths ranging from 2,400 to 28,000 feet.

Acting Secretary Roosevelt announced the facts of the invention and the results of the service test, talking with enthusiasm about it.

Dr. Harvey C. Hayes, physicist of the Naval Engineering Station at Annapolis, is the designer of the apparatus, and went on the U. S. S. *Stewart* to test it. He has cabled to the department that the experiment was a complete success and is now on his way home to give a detailed report.

Sound from an oscillator, installed in the after part of the ship, is projected against the ocean bed and rebounds, being received by sensitive *ears* in the forward part of the ship. The sound transmitter develops a high frequency vibration in a diaphragm, which is in contact with the water. The high note carries many miles, while the receiver also can detect signals from great distances.

Mr. Roosevelt said—"This invention is truly a remarkable one. It has taken a long time to chart ocean routes and survey the ocean, to learn some of its depths. Many of its depths have never been determined. Even where known depths are shown on hydrographic charts, it has been necessary to heave the lead. Vessels using this invention will not have to use the lead. The device automatically records the depth, in deep or shallow water, and does it instantaneously. It will revolutionize sailing and navigation. It will enable us easily to find the depth of the ocean where it is now undetermined. It is altogether probable, after ocean depths have been better mapped, that the use of this device will enable ships to determine their positions at sea merely by sounding out the ocean depths.

"During the cruise of the *Stewart* to Gibraltar exhaustive tests of the sounding apparatus were carried on. Daily reports were made by radio to the Navy Department. The reports show that during the whole cruise the apparatus worked without apparent error. The machine secured correct and rapid soundings with ease. The *Stewart* made the cruise in nine days. During that time over nine hundred soundings were taken at frequencies, varying between two and twenty minutes.

"The destroyer's movements while steaming steadily at fifteen knots, were not interfered with except for a two hour interval. During this period, it was shown that successful soundings can be taken at intervals of one minute in the deepest water. The outline of the bottom of the sea over the course, was minutely recorded between Josephine and Tysburg bank. The sea bottom there was found to consist of an extensive plateau, bordered by mountain and tablelands, some of which rose 4,000 feet above the plain. Several deep depressions, none of which are shown on charts, were also discovered. Positive depth data was secured in the vicinity of the Azores Islands, where the charts show only negative data.

"It is believed the outline of the trade routes should give any number of such land marks for use in finding a ship's position. The exploration of all the sea floor is possible by the use of this device."

Firework Making for Amateurs

By RAYMOND B. WAILES

(*Continued from page* 463)

used as smoke screens during the war.

1. Potassium nitrate
   Sulphur
   Arsenic trisulphide
   Use equal parts of each.
   This formula (above) gives a yellow smoke cloud.
2. Red phosphorous
   Arsenic
   Equal parts of each.

Both are poisonous if inhaled.

FIRECRACKERS

Our figure shows a recent noise-making firework. A strong paper tube (4) contains a soft but strong paper bag (9), filled with the following composition:

Potassium perchlorate	16 parts
Aluminum powder	14 parts
Sulphur	5 parts

The fuse (7) is inserted into the paper bag before the bag is tied with the soft string (10). The cracker gives a vivid white flash at night, with a very loud report. The absence of heavy slugs of paper render the cracker fairly safe. The paper bag can be substituted for by paper wads as the lower sketch shows.

The following compositions will work fairly well in a case described as above. They are nothing more than flashlight compositions.

1. Aluminum powder	4 parts
Potassium chlorate	10 parts
Sugar	1 part
2. Potassium chlorate	2 parts
Magnesium powder	1 part

FIRST FIRE COMPOSITIONS

These compositions are usually used to top any desired composition contained in a device. They make for quick and sure ignition of the body charge. They can be substituted, with some success, for ejecting charges of stars of Roman candles.

1. Potassium nitrate	57 parts
Sulphur	19 parts
Black antimony sulphide	19 parts
Dextrin	5 parts
2. Potassium nitrate	56 parts
Sulphur	12 parts
Charcoal	32 parts

Formula No. 2 above, is also called *meal powder*. It can be used as ejecting (driving) charge for stars in candles and propelling charges for rockets and Catharine (pin) wheels, figure 5.

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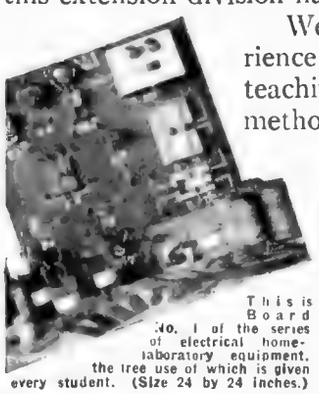

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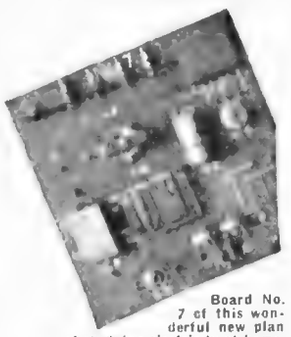

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Answers to Puzzles on Page 453

THE MECHANIC'S PULLEY SYSTEM.

This pulley system would not raise the weight under any circumstances or with any combination of weight and force. A careful inspection of the diagram will show that the movable pulleys B and C will tend to approach each other, thus allowing the weight to lower, instead of rise, no matter which way the pull is exerted on rope A.

THE FLOATING CAKE OF ICE.

Since every body displaces its own weight of the liquid in which it floats, it is evident that the water from the melted ice has the same volume as the volume of the water displaced by the ice before melting. Therefore no change in level will result on account of the melting of the ice.

THE FLOATING BALL TRICK.

It has often been shown that a moving stream of water or air exerts a relatively small lateral or sidewise pressure. The effect of the stream of air, then, is to continually sweep away air particles from above the ball, exerting at the same time against it a relatively small lateral pressure which would tend to make the ball drop. The greater pressure of the atmosphere, effective only from the opposite side of the ball, keeps the latter in close contact with the stream.

THE MYSTERIOUS BOAT.

This is a favorite experiment to illustrate surface tension. The strong attraction of particles of water for each other produces a compression of the particles near the surface which results in a thin elastic film on which light objects such as sewing needles may be supported. This film is highly elastic but is readily broken by anything which tends to spread the molecules of the surface film apart. All substances which dissolve in water, such as salt and sugar, will do this to some extent, but among the most effective substances are alcohol and gum camphor. The boat moves forward, then, because the gum camphor breaks the film around the stern of the boat while the contraction of the film adhering to the prow tends to pull the boat about on the water.

Under the same power a battleship would certainly move, albeit the velocity would be exceedingly slow. Since there is no statical friction produced by a motionless fluid there would be no force (at least until the battleship began to move) to oppose the motion of the ship. Even an exceedingly small force, then, would be sufficient to give it an initial, although small, velocity. Of course the great inertia of the vessel would retard any *change of motion* though it could not prevent it altogether, no matter how small the effective force.

THE BAROMETER TUBE.

The perpendicular height of a mercury column in a barometer depends only on the pressure of the atmosphere and the density of the mercury and not at all upon the size or shape of the tube. It would not matter in the least whether the tube was of uniform bore or not.

HOW MUCH ICE WAS MELTED BY THE SLIDE?

Neglecting friction against the air and a few other ways in which slight losses will occur, we may assume for the sake of the problem that all of the kinetic energy of the running boy will be converted into heat by friction against the ice and therefore a definite amount of ice will be melted by the slide. The kinetic energy of the boy is found by applying the formula:

$$\text{K. E.} = \frac{W\ V^2}{2\ g} = \frac{150 \times 20 \times 20}{2 \times 32.2} = \frac{60{,}000}{64.4} \text{ ft. lbs.}$$

Now since 778 foot pounds are equivalent to 1 B. T. U., and since 144 B. T. U. are required to melt a pound of ice, it is evident that the above number of foot pounds divided by the product of 778 and 144 will give the number of pounds of ice melted by the slide. This turns out to be 0.0083 pound.

Motion Pictures in Natural Colors

(*Continued from page 443*)

If we should now combine the two scenes, placing one on top of the other, and register them, we will obtain a negative, which combines all the colors in their correct comparative black and white intensity. This is exactly what Dr. Peck is doing, but in a very ingenious way. Upon the film (the positive), coated upon both sides with regular emulsion, both frames of the same scene, namely, the one taken thru the yellow-orange-red filter, and the one thru the blue-green filter, are printed simultaneously, one on one side of the film, and the other on the other side, and the result in the print is that two frames have been combined to form one picture, absolutely correct in color values, which rebuilds the scene again in black and white. In this manner the thirty-two pictures which had been taken before in one second, are halved in the printing process where the number again becomes standard for regular projection machines, that is, sixteen photos per second, will be projected when the same is placed in the projecting machine, because one picture of the scene has been printed upon one side, and the other picture upon the other side of the same space.

(*Continued on page 495*)

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Restoring the Moon

By BURNIE L. BEVILL

(*Continued from page* 435)

replied, somewhat piqued by Paul's manner.

But he had not time to remonstrate, for at that moment a bell-boy made his appearance in the doorway and announced that there was a gentleman by the name of Edgar Stallas in the salon below waiting for us.

We descended at once and were immediately confronted by a tall, wiry individual, who at first glance appeared to be a native of some Latin country, but who, we soon learned, was an Englishman.

"I believe I am speaking to two gentlemen representing the New York *Gazette*," he began. Upon being assured that his surmise was correct, he continued:

"I suppose you have heard of the unusual condition of the atmosphere this morning?" There was a rising inflection in his tone, and we both nodded.

"I am a detective," he went on, "and my specialty is the investigation of such phenomena as that with which we are now confronted. I have been appointed to investigate this case, and am in need of two capable assistants."

"You couldn't have picked a better pair," said Paul quickly. "We have been in the service of the *Gazette* for the better part of four years, and what we don't know about everything from the price of wheat to inter-atomic force hasn't been heard of yet."

I was not so enthusiastic as Paul; yet I reasoned that if anyone could render the detective valuable assistance it would be Paul or myself. As the detective seemed to be genuinely desirous of our assistance, we consented to aid him in his undertaking, provided the *Gazette* would sanction our doing so.

Accordingly, Stallas agreed to go at once to the office of the *Gazette* and make arrangements for our plan for assisting him to search for the maniac that was endangering the lives of the entire population of the globe.

About an hour later we received a telephone call from the *Gazette*, authorizing us to accompany Stallas to the Bermudas upon his hunt for the scientific criminal.

Monday morning we embarked upon the Alton liner, *Savants*, for Hamilton, Bermuda. Not a soul on board was aware of the mission of the strange looking man who had the foreign appearance and of the two reporters who accompanied him.

The *Savants* was equipped with the very latest scientific appliances, including a thoroughly arranged system of radiophones in each stateroom. Thus we were able to keep in constant touch with the sources of information at home.

One of the first reports we received was to the effect that the atmospheric pressure had lowered another two pounds during Sunday night. Quite a consternation was created among the passengers, and great were the discussions concerning the phenomenon and its cause. Several passengers were seen to faint upon the upper deck for lack of sufficient air to breathe, and upon the following morning, when it was noticed that the air was still lighter, the excitement waxed very great indeed. Quite a number of the more religiously inclined began to go down on their knees and pray.

About three o'clock in the afternoon of the second day out, we reached Hamilton. There we found the population manifesting various degrees and kinds of fear. The report had somehow obtained circulation that the wind had blown from the north all the preceding night at St. George, a small town

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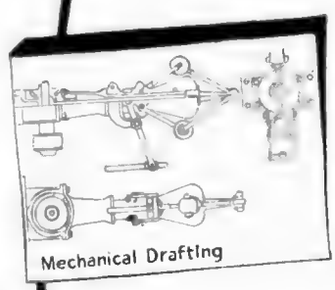

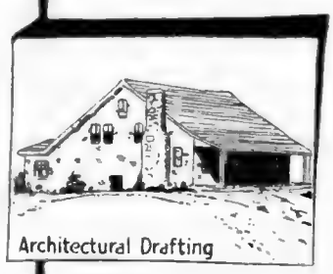

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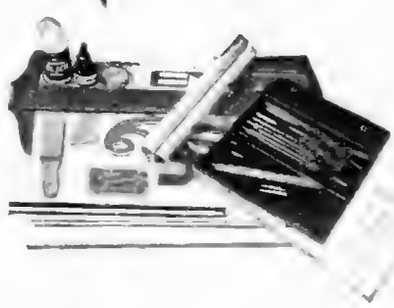

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in the extreme western and northern end of the group of islands. As the islands lie in the Gulf Stream and the wind, therefore, blows almost constantly from the south, this report, coupled with the lowered atmospheric pressure, was creating a great deal of alarm.

We put up at the Princess Hotel, which is the principal hostelry of the islands, and prepared to rest while Stallas went out to make arrangements with the Governor-General of the islands for permission to make investigations in his domain; this preliminary measure being rendered necessary because of the fact that the islands are under the control of Great Britain.

Paul and I did nothing until the following morning, when we embarked in a small electric launch that Stallas had ready for us, and made our way toward the northern part of the islands, where, as Stallas explained, an investigation was to be started in connection with the report of the contrary wind. After about two hours' sailing—or, I should say, motoring—we ran the launch in upon a reef and made a landing upon a sandy beach. Stallas proceeded to lead us inland toward a grove of palmettoes that extended to some distance in the direction of the shore. When we had entered the grove and had proceeded to a considerable distance among the trees we observed that Stallas began to take on a sneaking look. A moment later, as we turned to regard each other questioningly, we were confronted by a revolver and commanded to submit quietly to being manacled. Stallas was firm and he had the weapon, so there was nothing for us to do but to yield.

"My good men," began Stallas, the instant the handcuffs were clasped upon our wrists, "what fools some mortals be. Here I have brought you upon this wild goose chase to help me accomplish my own designs. Perhaps you would like to know that I am not a detective at all, but one of the cleverest scientists of the age, and we are approaching my private laboratory. Had you not been extremely ignorant, you would have inquired why I brought you to the Bermudas; but you did not. Instead, you followed me blindly, asking no questions, buoyed up by the promise of fame should you be able to unravel the mystery of the diminished atmosphere. It was I who telephoned you representing myself to be connected with the *Gazette* and authorizing you to come with me. My purpose in having you two here is that you may give me a 'write up' in your paper when you reach home, if you ever do."

His face had taken on an insane expression and we concluded that fate had thrust us into the clutches of a maniac.

"Very soon you will see the most completely equipped laboratory and scientific institution that it ever fell to the lot of a human being to behold," he continued. "I have a large manufacturing plant in England that keeps me supplied with apparatus and materials as needed, under absolute secrecy. You see, it is like this: I have discovered a way to repopulate the moon. This will seem a somewhat startling announcement to you, because of your limited knowledge of things scientific, but after you have learned more my theory will seem far more sane that at present it appears to you. After four years of close research, I have found that the moon of four million years ago was inhabited by a race of people very closely akin to our present earth-people. Subsequently, after the lapse of a million years, the moon began to lose its atmosphere and moisture, owing to the fact that the curved light waves from the sun, upon striking the surface of the moon, caused the upper stratum of her atmosphere to become ionized and to pass off into space tangently from the surface of the ground. This liberated air, upon receiving such a velocity, was unable to check its speed until it had gone beyond the gravitation of the moon and, as the earth's gravitation was stronger than that of the moon, the moon's atmosphere was absorbed by the earth. Now, as the moon was robbed of its air by the earth, I propose to give it back, and I have already given back about one-fourth of it."

We were dumbfounded by this announcement. To think that a mere man had upset God's laws and caused a part of the earth's atmosphere to be given to the moon at the earth's expense was beyond our enfeebled minds to grasp at this time.

"I say, old top!" burst out Paul, "are you not going a little too far this time? Don't you think that we can use our atmosphere ourselves to better advantage than they can on the moon, especially when taking cognizance of the fact that there are no people on that planet at present?"

"Why, my dear fellow," replied Stallas, "you don't seem to catch the idea at all. I intend to repopulate the moon, and as there are mineral deposits upon the moon that would make us earth-people all rich in the extreme, don't you think it worth while to pay her a visit? This we cannot do at present, for it would be quite impossible to live there without air or water. I have invented what I call a moon-car that will be capable of carrying twenty persons to the moon in the space of one hour, but more of this presently—we are approaching my stronghold."

A large, low, rambling structure, built of cement, came into view. There appeared to be no windows to the building and only one door that we could discern. It was through this that we entered several minutes later to be ushered into what appeared to be the finest equipped palace we had ever seen. Great velvet carpets were strewn profusely upon the floor and the most luxuriously finished ebony furniture was placed conveniently about the room. We were next led into the telescope room, where we were confronted with what we later found to be the largest telescope in existence. I noticed that there was no ceiling in this room.

"Gentlemen," said Stallas, "this is the largest and most powerful telescope in the world today. It was made expressly for me by the famous lens makers of Bucharest, at a cost of a half million dollars. By its aid I can bring the moon down until it appears to be within a stone's throw of me and I can see anything that chances to come within my range as plainly and as perfectly as I can see you two gentlemen at my side. If you wish, you may take a look at the moon yourselves. It is already in focus, as I keep it in readiness at all times."

I applied my eye to the eye-piece, and instantly a sight met my gaze such as appalled me beyond description. Just beneath me there appeared to be a small mummy of a man, about the size of the ancient Egyptian specimens I had seen. Upon a rock beside him was a group of strangely carved symbols that were explained by Stallas, who said that they represented the universal written language of the moon-dwellers of four million years ago. While my gaze was riveted upon the stone there was a sudden puff of smoke and the stone was blown to atoms.

"That explosion," said Stallas, "was caused by my letting loose two million tons of interatomic force by the application of two ounces of trioxic acid to one dram of lead subradicite and by directing it to the stone upon the moon by my especially contrived chemical gun—the stone, as you observed, was atomized.

"I'll wager that you gentlemen had not noticed that the moon is nowhere to be seen in the heavens, as it has not yet arisen. How do you suppose that you have been enable to view it under those conditions? It is by the use of the curved light radiations that Einstein has mentioned in his treatise, and which I have been able to control just as easily as you would control radio waves."

Stallas next led us into the *anti-gravitation room,* as he called it. It was a large circular space about two hundred feet in diameter; and in the center of this space was a tremendous metallic disc lying upon the floor. It was some hundred feet in diameter and upon either side of it were what appeared to be two huge electrodes. The explanation of all this was not long in coming.

"This," announced Stallas, "is the gravity-suspending room. I have, I think you will admit, the honorable professor, Comarie, of the French Academy outdistanced entirely in his own special line of research. I have discovered that by charging a brass disc with electricity, by causing a current at a billion volts to pass over it in the form of a powerful spark, everything above the disc is rendered without weight. I have found that the air above this disc, owing to its being without weight, is forced upward by the pressure of the air that surrounds it. Hence it is forced into outer space, and because of the fact that the upper atmosphere is in an ionized condition it is, upon being thrown out of the gravitationless area by rotation of the earth, prevented from returning to the earth. Gravitation is becoming more and more to be recognized as nothing more or less than electrification, positive and negative. The earth is possessed of positive electrification and the moon, having been at one time a part of the earth, is also possessed of a positive charge. Consequently, as like charges repel each other, the moon is kept away from the earth. By my method, the positive charge within the confines of the disc is overcome by my giving the disc an equal negative charge, thus destroying gravitation within this area. Should I give it a positive charge, it would have double gravitation.

"My purpose is to send to the moon each night a small amount of air so that we earth-people can gradually accustom ourselves to the rarefied atmosphere. The way this is accomplished is obvious. The rising air over the disc, upon being released just as the moon is passing overhead, is attracted by the gravitation of the moon and caused to fall, so to speak, to the moon. The ordinary atmosphere of this locality has enough moisture in it to furnish water for the moon upon condensation. Tonight I shall send the last quota of air to the moon, and you gentlemen shall witness the proceedings and report to your paper; or it may be that I will change my mind and visit the moon tonight, in which event I shall take you gentlemen with me."

Cold, paralyzing fear gripped at my heart, and the perspiration was bursting from Paul's face as though he were suffering from dreadful emotion. "Great God!" I burst out, "what would you do, man? Would you destroy the world to please this fancy of yours? Would you change the immutable laws of God and take away the air that we breathe in order to attempt to repopulate the moon?"

"Wait and you shall see," said Stallas, as he led us across the huge metal disc to the opposite side. Thrusting us into a niche conveniently placed in the wall, he pressed a button close by, and, to our astonishment, a plate glass screen began to descend in front of us—we were caged. Stallas walked across to another niche and proceeded to cage himself in like manner, when suddenly we beheld the full moon arising majestically above the edge of the enclosure. In an instant pandemonium was turned loose—a powerful electric spark flashed across the screen between the electrodes, and a mighty whirring as of a tornado assailed our ears—the disc was in operation—our atmosphere was being sent to the moon. It was ghastly in the extreme to think that this misguided man was wrecking our beautiful planet by his crazy idea. With horrible fascination we listened to the tremendous roar of the rush-

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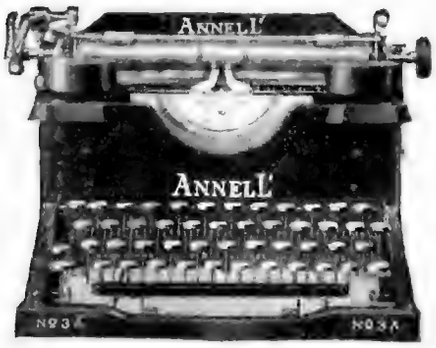

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ing air, rushing straight from the disc into outer space. I have never been what one might term a religious man, but if I ever was inclined to pray it was at that moment, when I realized that the air was rapidly being exhausted from our glass cage by the suction. However, I soon perceived that we were being supplied with air by some force to counteract the action of the disc. It was indeed a genius that had inveigled us into his power.

After the lapse of about two hours, the huge glass screen was raised from our cage and we perceived that the disc had ceased its action and that all was quiet again. Stallas soon made his appearance and announced that he was preparing to embark for the moon in his moon-car. So saying, he entered a door in the wall and disappeared. We were quite astonished that he had left us standing there apparently free. In an instant, however, we discovered to our utter amazement that we were unable to move a muscle owing to a dizziness suddenly having taken possession of us. I could distinguish the odor of some drug, but was unable to identify it and we decided that this must be the cause of the dizziness.

After the lapse of several minutes, there emerged from the door that Stallas had entered, a grotesque-looking vehicle with two small wheels upon which to run on the ground. Resting on these wheels was a box-like cabin that appeared to be made of sheet steel, and upon the side of which we discerned a small door. Upon the very top of the machine there was a tremendous leaden ball some twenty feet in diameter, which was held in place by huge steel girders attached to the cabin. How the apparatus was balanced we could not tell at present. Stallas, however, soon appeared and made this point clear to us.

"My good men," said he, "what you see before you is my moon-car. By its aid we will very soon be on our journey to the moon. It is operated by the same laws that govern the disc. In other words, it is controlled by the force of counter-gravitation. By the use of a compact, powerful generator within the cabin, I can create sufficient voltage to generate enough positive gravitation to overcome that of the earth and we sail gracefully away into space. The charge is distributed evenly over the surface of the leaden ball and it is controlled in this manner. By resisting the gravitation of the earth and submitting to the gravitation of the moon, we are enabled to reach the moon in the space of one hour."

Stallas thereupon opened the little door in the side of the cabin and entered, bidding us to do the same. By this time the odor of the drug had vanished from the air and with it our paralysis of a moment before. As we started to enter, the door suddenly slammed to leaving us on the outside. Through a speaking tube that protruded from the door, Stallas shouted, "My God, men, I am locked in by the automatic device that closes the door at a set time! I miscalculated the time and in five minutes more the disc again begins its action by an automatic suction. There is a switch that controls it, but I cannot possibly reach it—we are lost!"

His own folly had brought about his destruction, and Paul and I decided to leave him to his fate and make our escape, if possible, ere our strange friend's mechanical devices started to operate.

Seeing that the door from which the moon-car had emerged was still ajar, we ran for it, and soon discovered that it led to the shore of a small inlet of the bay over which the structure had been built. With a mighty effort, we smashed our manacles upon the stone wall, leaped into the electric launch that we found moored there and glided rapidly out into safety. We did not pause in our flight until we had covered some five hundred yards, and then as we glanced back we saw a huge black object hurled upward

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into space with the speed of a bullet, and a mighty roar assailed our ears. The disc was again in action—more of our precious air was being driven off into space. What could we do? Fumbling around in the bottom of the launch, I came upon a small, black metal box. Upon one side of this box two small porcelain knobs protruded. I noticed that one of them was marked positive and the other negative, and also that the negative knob was thrust forward while the positive knob was standing straight. A heaven-born idea came to me, and I quickly thrust forward the positive knob and pulled back the negative. Immediately, the roaring ceased. I had won! A moment later the heavens were opened, and with a hissing sound, a tremendous object fell from the sky and crashed into Stallas's stone structure, shattering the building by the impact. We now observed that this gigantic object greatly resembled an iceberg, and upon investigation we learned that this huge mass was nothing but frozen atmosphere that had been solidified by the extreme cold of outer space. Apparently, the positive charge had made the disc doubly powerful, so that it must have drawn the huge, frozen mass upon itself and thereby destroyed itself completely

For a week afterward it hailed these monstrous masses of frozen air over the face of the earth, and during the following winter thousands of people were frozen to death owing to the lowering of the general temperature of the entire world, by the frozen masses of air.

In a few minutes we reached Hamilton with our story and wired it to the *Gazette*. We learned that the Governor-General had never authorized Stallas to conduct his investigations upon the islands, and it was proved that Stallas alone was responsible for what had occurred.

Great were the rejoicings when it was learned that the criminal was dead and that the world was safe. A great celebration awaited us in New York, and we were treated to universal acclaim and hailed everywhere as heroes, because we had, through our own folly, come to the rescue of the world.

The End of the World—How Soon?

By IVAN L. SMITH

(*Continued from page* 436)

veloped so that it became possible to measure the amount of heat which our luminary is constantly radiating, it was found that a mass equal in size to the sun, and composed of the most perfectly combustible substance known, would not suffice to keep up its heat for more than 1,500 years. It is now agreed that the heat radiated from the sun is the result of contraction of its mass, with the possible addition of some heat resulting from the breaking up of radio-active compounds. No other causes known to us could generate such a prodigious amount of heat as has been radiated by the sun in the uncounted years of its existence. If the nebular theory of the solar system's origin is accepted, we know that the material composing the sun was once diffused over a space at least as great as that bounded by the orbit of Neptune. A vast amount of contraction has therefore already taken place and this contraction is still proceeding at an appreciable rate

Any stellar body starts out with a definite amount of inherent energy in the form of heat, motion, or perhaps locked up in chemical combinations. This energy is changeable in form, as may be observed when the motion energy of a bullet is changed to heat energy upon the sudden cessation of the bullet's motion, but no way of adding to this total of initial energy has yet been found Therefore, it is evident that the heat energy which the sun is so lavishly radiating through

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space cannot be replaced and is not inexhaustible. If it continues long enough the sun will some day have contracted to the point where its matter begins to assume a solid form and will then cool rapidly until it no longer gives forth either heat or light. Its planets will then be dead worlds with the freezing temperatures of interstellar space.

All of the above discussions have assumed that our world is going to die literally of "old age." We can safely assert that every man is going to die sooner or later of hardening of the arteries, dropsy or some other natural cause IF some accident doesn't cut short his earthly career before the inevitable advance of old age accomplishes it. In the same way, we must qualify the discussion of the probable end of this world by saying that one of the above forces will probably bring its end about, unless some unforeseen accident prevents these forces from working to their logical conclusion. Planets are just as subject to accident as human beings are. The most probable accident which could bring an untimely end to the earth is collision. Every now and then astronomers are startled to see a new star blazing out in the heavens where no star was previously visible, or have seen a comparatively dull, insignificant star suddenly flame out until it has reached the first or second magnitude. There are countless visible suns shooting throughout space, in apparently unrelated directions. In addition to the visible suns we have every reason to believe that there are a large number of suns which have long since cooled below the incandescent point, also traveling along through space. It is only reasonable to assume that there is going to be an occasional collision and the heat generated by the sudden impact of two suns would be sufficient to raise the whole mass to incandescence, whereupon a new star would be visible to us.

Assuming that the sudden appearance of new stars is the direct result of collision of heavenly bodies, have we any reason to believe that our own sun is exempt from such danger? The answer must be in the negative. Our sun with his train of planets is traveling in the general direction of the constellation Hercules at the respectable rate of 12 miles per second. So far as we can see he has a clear track for several millions of years, but there is no assurance whatever that some invisible body is not lying somewhere along the line prepared to ditch us. The presence of such an intruder would be felt long before the collision actually took place, because of the disturbing influence which its mass would exert on the orbital movement of the outlying planets. This disturbance would increase in intensity as the sun and the dead star narrowed the distance between them until they were actually torn apart by the mutual gravitational forces operating.

No human being would ever live to witness the final catastrophe. In a system so nicely adjusted as ours, it does not require a very strong outside influence to throw it completely out of gear, and it is quite probable that long before the collision, life would have become extinct as the result of the derangement of our days, seasons and years, which the intrusion of an outside body would be sure to affect.

When is the world going to end? We do not know. Every few months some religious fanatic sets the exact date and hour, but somehow the earth manages to roll right along. Scientists prefer not to risk their reputations, so don't say just how many million years it will take the earth to succumb to advanced senility, and naturally, nobody can figure just when an accident is likely to upset all their beautiful calculations. In order to reassure the timid, however, the writer is so far willing to risk his good name as to state that the end is probably sufficiently far removed to allow the completion of any long-time contracts at present outstanding.

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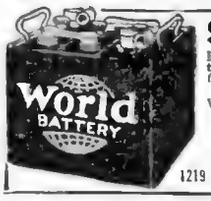

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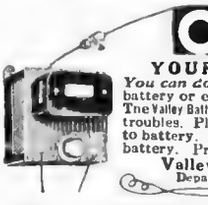

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Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(Continued from page 434)

message, and it is printed simultaneously in all the stock-tickers in the city. Now it struck me as curious that no one had ever yet realized how easy it would be to save transportation charges and valuable time by having newspapers and books printed in a like manner. I accordingly made arrangements with a newspaper syndicate. A linotype operator here in New York sets up his type, but his motions are duplicated by telegraph in various cities throughout the United States, where duplicate linotype machines automatically set up the type in unison. The newspaper is thus set up in many cities at once, and copies may be run off distant presses at the same time as in New York, saving much valuable time and heavy transportation expenses. Books and magazines may of course be printed in a like manner.

"From this came the idea of printing one copy of the paper in New York in special ink. By placing this copy on a machine here using Edison's telautograph, the original will reproduce thousands of copies at once in different cities. In Edison's machine a single stylus travels across the page and makes connection when it passes over the ink which is a conductor of electricity. I have improved on the machine by using a comb containing several hundred independent styluses which pass over the paper, so that an entire newspaper page may be printed in a second or less—the result being not one copy, but thousands of copies—one at each instrument in the circuit.

"My next step was to extend the process to manufacturing merchandise in quantities. It is foolish to have a workman spend an hour making a pair of shoes or assembling the parts of a watch when electricity can be made to repeat his motions in thousands of different places at once. This time I was obliged to use, as in the linotype machine, the principle of a telautograph, Gray's instrument, which unlike Edison's, causes a motion at one end of the instrument to be repeated at the other end. At each station the various parts of a watch are fed automatically to an assembling machine, just as matrices are in the linotype machine. An expert in New York works his machine and, when he is through, has assembled not only his own watch but a thousand other watches in different cities. And so with all other manufactures. A hundred thousand duplicates can be made at the same time as the original. Even art work can be thus duplicated. An artist paints one picture and his motions transmitted by the electrical current can produce as many duplicates as desired. For sculpture I followed a different plan—and one which I afterward found very useful for all kinds of manufactured goods. I took a finished statue, and by making a metal finger travel around its contours, and transmitting the motion to a carving tool traveling over a block of marble at another place, this block is cut to the exact size and shape of the original model, or, if desired, could be automatically enlarged or reduced. Hundreds of statues may thus be carved at the same time in different shops. So with other objects. I place a coupling in the sending apparatus, and at the receiving stations a hundred thousand similar couplings are reproduced automatically.

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Doctor Hackensaw paused a moment and then continued: "I suppose you know what an electrolyte is?"

"Not guilty!" cried Silas Rockett with a laugh.

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In all branches of telephone practice science has similarly contributed to economy. Even in such a comparatively small item as switchboard cords, improvements have reduced the cost of renewal by four million dollars a year.

Every new telephone added to the Bell System increases the usefulness of *all* telephones, but this multiplication tends likewise to increase the complications and the expense of service. The scientists of the Bell System, to offset this tendency, are constantly called upon to develop new devices which simplify complications and keep down costs.

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"Never mind. You know at least that when an electrical current is sent through water with a salt or acid in solution, it decomposes some of the water and sends the oxygen atoms to one pole and the hydrogen atoms to the other. These travelling particles of matter are called "ions," and my problem was to arrange matters so that after decomposing the water or other object in one spot I could make both the positive and the negative ions travel to some other spot and there combine again. The problem looked very simple, but it took years of experimenting to solve it. Evidently two wires would be necessary, since the ions travel in opposite directions, but these two wires could easily be brought together again when the oxygen and hydrogen were to be reunited.

H——————— H_2O
O———————

Here is a rough diagram of the wires. Of course I used hollow wires at first, and in the wires kept an acidulated solution through which the ions could pass. By this method, when I had discovered an electrolyte or solution that would offer but slight resistance to the passage of the ions, I was able to silver-plate an object several miles away. In other words I sent particles of silver several miles by means of the electrical current. Then I turned my attention to sending the bodies by wireless. *Undirected wireless* would of course be out of the question for the particles of silver would be scattered in all directions, and only an infinitesimal portion would reach the desired spot. The wireless waves must evidently be *directed*. To accomplish this, I first used a wire for directing the radio waves—wired wireless, as it is called, and you may imagine my gratification when I sent my first object—a metal coin through the air to a receiving instrument a mile away, and had it arrive in perfect condition. Later, I was able to do away with the wire altogether, having found means of directing my wireless waves, and now I can transmit practically any body whatever from one of my stations to any other."

"Have you put your invention to any practical use?"

"Yes indeed. I have my machines installed in a number of mines—copper and iron mines especially, and I transmit thousands of tons of metal daily by wireless."

"Isn't that rather expensive?"

"It is less expensive than freight, for my electrical power derived from the waves of the Atlantic costs me very little. But I do not confine myself to mining operations. I am now able to send plants by wireless, and even living animals!"

"Surely, doctor, you are joking. How could you transport the particles of an animal from one point to another without destroying the animal?"

"Simply enough. The trip requires but a small fraction of a second. I first make the animal unconscious, so that in its struggles it will not displace any of its organs. The current itself does not injure any of the tissues, but transmits each particle instantaneously in its proper position. The animal hasn't time to know it is dead before it has arrived at its destination, and there a suitable electric shock brings it to life again. The entire process only occupies a few seconds, and you probably know, Silas, that your heart could cease beating for a few seconds, and then be started again without any trouble."

Silas Rockett was nonplussed. "I believe you, doctor," said he, "but could you not give me a practical demonstration?"

"Certainly, with pleasure, and on yourself, too!" The reporter backed off precipitately: "No," said he. "I'd rather see the experiment performed on some less valuable animal."

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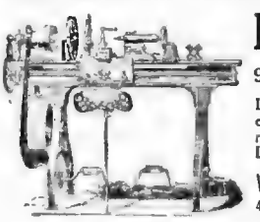

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"I am experimenting now on animals, seeking to change their shape as they travel through the air from place to place. So far I have only been partially successful. I find I can make minor changes, but any great change renders it impossible to start life again after the animal has reached its destination. But I find, to my joy, that I shall be able to make changes that will have considerable practical value. For example, I can transmit, by wireless, a child with deformed arms and legs, and have it arrive at the other end with normal limbs. I can also take a homely girl, start her from this end and have her appear at the receiving station a perfect beauty.

"Then, too, I am using my method for the cure of disease. I noticed that a body, after transmission, was almost always in better health than before. I attribute this to the effect of the electrical current in killing some of the disease germs. So, by using suitable methods, I am able to place a sick person at one end of the room, transmit him to the other end and have him arrive there full of health and vigor! What do you say to that, Silas?"

"It is too good to be true!" replied Silas.

At this juncture, the door opened and the servant ushered in a young man about thirty.

"Well, doctor," cried the young man as he bustled into the room, "Have you any news yet of that scoundrel for me?"

"Not much, I confess," replied the doctor, but enough to lead me to believe that Marty Morecash is coming to New York to-day. But allow me to present you to Mr. Silas Rockett, reporter for the *New York Daily Growl*. Silas, this gentleman is Mr. Chess Bixby, and he has asked me to find his fiancée for him, the young lady having been kidnapped by an unprincipled fellow named Morecash. I know the man, for he was formerly foreman in an important copper mine and he ran away with a large sum of the firm's money, and several of my "Transmission Apparatus." The police are after him, but he always manages to escape them by means of the apparatus. He has at least three stations—one in San Francisco, one in Chicago and one in New York, and whenever the police are too close upon his heels, he sends his body by wireless from one station to the other, and so escapes them."

Here the young man interrupted impatiently. "That's all very well, doctor," said he, "but what about the girl? Have you any news of ELMA WEST?"

Dr. Hackensaw shook his head. "No," said he, "I have no news of her. But I caught Marty Morecash's signals this morning as he aimed his wireless transmission wave toward New York. I think it likely that he is about to transmit his body to New York. If so, I have a little surprise in store for him. But listen—there goes my alarm now! Come, boys, and I'll show you something interesting. I have found means of deflecting Marty's waves and bringing them here. It may be only some stolen property that the fellow is sending here by radio, but even so, I can promise you that you will see something that you never saw before."

So saying, the doctor hastily tuned up his instrument, little dreaming what it was that was on its way through the ether.

All three men gazed intently at the receiving terminal, which was entirely encased in glass so as to prevent the slightest current of air that might prevent the proper reuniting of the ions of the transmitted body.

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mist could be seen. Gradually this mist became denser in spots, and little by little began to assume a definite form.

"Great Heavens!" exclaimed Dr. Hackensaw, as he gazed open-mouthed at the object which was gradually taking shape in the receiver: "Great Heavens! It's a human leg that's coming over by wireless!"

It was a human leg, and the delicacy of the tissues showed without doubt that it belonged to one of the fair sex, and a very young person at that! This was further confirmed by the beautiful silk hose and the delicate Venetian point lace that encircled the limb.

Gradually, before the astonished eyes of the spectators, the trunk and arms appeared, and finally the head, the face being that of a beautiful young girl of twenty.

There was no need of asking Chess Bixby if this was his fiancée Elma West. The thing was patent at a glance. Chess was leaning breathless over the instrument, watching dazedly as the young girl was created before their eyes, apparently out of nothing.

When the instrument ceased working, the maiden lay extended before them, as in a trance, perfect in every respect, clothing and all.

Dr. Hackensaw disconnected the vacuum tube and inserted a new one in its place. Then he set about resuscitating the girl. The glass tube was opened, and electric current passed through the girl, and she awoke with a start.

At this moment all were startled by a cry from Silas Rockett.

"Look! Look!" he cried. "There is something else coming over the wire!"

Surely enough. While the trio had been busy resuscitating the girl a new object had come into the receiving instrument.

"Great snakes!" cried Silas. "If it isn't a man's leg this time, I'll eat my hat!"

"Yes, it's Marty Morecash's leg that's coming over this time," said Chess Bixby gritting his teeth, "and when I'm done with him there won't be much left of Marty or that check-suit of his."

And then something happened. When the body was about half over, a short circuit must have occurred somewhere, for there was a violent explosion, the vacuum tube was shivered into fragments, and the almost completed body it contained was disrupted and sent flying in the air in all directions!

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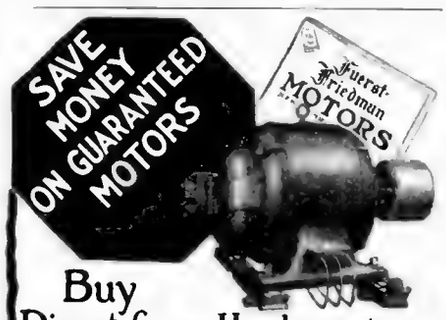

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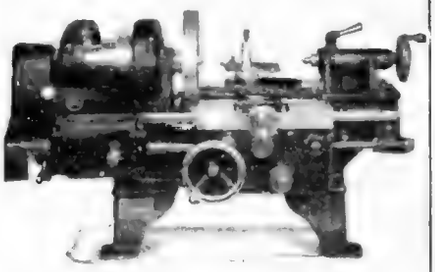

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Motion Pictures in Natural Colors

(*Continued from page* 484)

Up to this point, the process is rather simple, but difficulties mostly chemical in nature are encountered in what now takes place. The film positives are now completed, and redeveloped just the same as in the sepia redeveloping process and then washed, but the redeveloping process is remarkably different in the effects it produces. The film passes over cleverly constructed ducts, which contain the redeveloping solution.

Let us journey with the film thru its respective changes. The film is first placed in the camera and the scene photographed, at twice the normal speed. This negative is then developed in the regular manner, and the result is sixteen frames per foot for one set of colors and a like number for the other class. Another film is then used as a positive, which film has a coating on both sides, and the two adjacent photographs of one scene taken at the same moment are printed, one on one side of the double-coated film and the other on the back of the same space. This positive film is now developed in large tanks. It is then fixed and subsequently bleached, so that all trace of any image has left the film entirely. The film now passes to the coloring redevelopers. This redeveloping solution acts in the following manner on the yellow-orange-red side of the film. The yellow is the stronger solution, and dyes placed in the redeveloper will permit this yellow to act very rapidly. If the intensity of the former black and white image was very light, upon redeveloping, the yellow will affect the film, and an amount of yellow equal to the black and white intensity will be deposited. If the black and white intensity has been very heavy, then the slower acting red color is deposited upon the film in an intensity equivalent to the amount of black and white that had been bleached out in the bleaching process.

So, it is natural that the three colors which are used in one solution, namely the yellow, orange and red, are deposited upon the film on one side in a density corresponding to the former intensity of the black and white image. The ducts which feed these solutions to the film, distribute the solution in such a manner that it affects the one side of the film as it passes along its seemingly endless journey, and then at the end of the color tanks, it turns upward, and is acted upon by the blue and green colors on its reverse side speeding thru respective ducts.

From here the film passes into the special drying tanks, and is automatically wound upon spools.

When the film finally comes out, it presents the most perfect example of automatic coloring art yet produced. On one side the film is colored with red, yellow and orange, on the other the same space, and the same objects are colored with blue and green. Combinations of these colors make it possible to get jade, black, silver, gold, or almost any color imaginable. There is no halation, and no distortion, and regardless of how rapidly the objects may move, the color locates itself on the proper spots at the proper time; consequently, no color fringe is possible.

ROARING METEOR IN CANADA

A meteor fell in Big Quill, Sask., Canada, recently with a great roar and explosion that frightened people and animals for miles around. Bottles fell from their shelves and pictures swayed upon the walls. Great clouds of steam and smoke shot through the clear sky, and many climbed upon housetops—some to see the phenomenon and others to pray.

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Discounting the Count

A COUNT used to be a man in charge of a count of 500 persons to whom he was a sort of overlord. This is not true today because of altered political conditions. We still have Counts, but the Count business has changed somewhat.

Business, of all kinds, has undergone something of a revolution. It was not so many years ago that pack peddlers were the sole distributors and transporters of many of the household articles of the day. Their legs set the limits for most distribution problems in those days.

Modern transportation, progressive sales methods—*and advertising*—have broken the shackles of time. They make a speedy job of what used to take years. Through advertising many an article has been introduced simultaneously in stores all over the country.

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Balsa Wood Iceless Containers

(*Continued from page* 444)

four hour period; or, they are constructed just to carry home and hold for a few hours the quart brick bought at the soda fountain, store or ice cream parlor—a "Cash and Carry Ice Cream Box"—so light and convenient that father will bring it out from town with him in the evening, or mother will stop for the dinner's dessert as she goes home from the afternoon tea or card party.

Are you planning a week-end auto trip? Don't you want to take some ice cream with you? A suitably constructed Balsa box, a little tin container holding a special liquid to be frozen in the ice cream man's "hardening room" to a much colder ice than that of ordinary water, well hardened ice cream—all compactly and neatly fitted into the box—and the trick is accomplished. You have an ice cream supply which can be drawn upon for twenty-four hours.

Of greatest interest, however, from the manufacturer's viewpoint is the *ice cream cabinet*, or chest, from which the soda man dispenses sundaes, Eskimo pies, plain ice creams and other frozen dainties. Made of Balsa, and supplied with *refrigerating pads*, these cabinets do away with ice and salt and maintain the cream at just the most desirable temperature for eating. They are clean, light in weight, easily knocked down for shipping or storage, and wear indefinitely because there is no melting ice to cause deterioration.

Of course, since Balsa boxes can so successfully maintain refrigeration in ice cream, the most difficult of all frozen products to handle, it goes without saying that they can be used for other perishables. Fancy fruits from the tropics, chilled before shipment, come north in Balsa boxes by express—or even by parcel post. Compressed yeast is going from the factory to the retail dealer packed in Balsa containers. And, most striking of all, fresh fish, chilled just as soon as it is taken out of the water by dry, cold air to almost its freezing point, is wrapped in parchment paper and sent by parcel post to the consumer, provided he is not more than twenty-four hours from the water. No, this is not a fairy story! It's a cold(!) commercial fact—based on a business which has been in operation for a year. This dry packed, refrigerated fish is as much of a revelation to the consumer, who appreciates quality, as was the dry packed poultry which, years ago, largely replaced the water soaked bird shipped to the city in big barrels half filled with chopped ice. In both cases, the flavor so much desired is retained.

Such adaptations of the small Balsa container to the preservation and distribution of perishables requiring low temperatures are but indications of the wide uses to which these boxes can be put. They are an important link in the distribution chain from producer to consumer and as such command the interest of both shipper and consumer.

With a refrigerating pad and three inches of Balsa wood, ice cream can easily be held for twenty-four hours. The usual five-gallon ice cream tub packed with ice and salt weighs about 150 pounds. The balsa tub, loaded, weighs about 100 pounds. One of the problems of the ice cream industry is the keeping of the cream in the shop of the retailer. Ordinarily, this is accomplished by placing the cans of cream in a box—or "cabinet," as it is called—and packing ice and salt around them. Repacking must be done every 24 hours at least. The actual expense for material and labor is great and from every viewpoint the process is undesirable. Cabinets are now being made of balsa, suitably sheathed for protection against surface wear, from which ice cream can be served for twenty-four hours under such conditions as ordinarily prevail in ice cream parlors and at soda fountains.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

POULTRY FEEDER

(628) Lester Bogart of Bloomfield, N. J., asks advice on an automatic poultry feeder.

A. There have been 14 or 15 different automatic chicken feeders, some of which are being made by the leading poultry supply houses.

Although your device is probably patentable, we do not believe that you will realize a great sale from the same, and therefore, do not advise such patent procedure.

COMBINATION TAP AND DRILL

(629) John E. Burbank of Brunswick, Me., asks whether he can obtain a patent upon a combination drill and tap tool.

A. The idea which you have advanced, that is, combining a drill and a tap into a one-piece tool is nothing new. It has been upon the market for years and we doubt very much whether you can obtain a patent for same unless you make some radical change in the design.

WAVE LENGTH CHANGER

(630) Harland Brownfield of Champaign, Ill., asks whether he can secure a worthwhile patent on a transmitting wave-length changer.

A. In our opinion there is nothing new or novel in your method of changing the wave length of transmitting stations.

We do not advise a patent upon the idea, as we do not believe that you can secure a favorable market for the same. As a matter of fact we doubt that you can even secure a patent upon this system.

FRUIT WRAPPER

(631) Chas. H. Brocksmith of Bicknell, Ind., submits ideas of a fruit wrapper and a suggestion for a screen door. He requests our opinion on both suggestions.

A. We would state that we do not think very much of either of the two ideas forwarded by you.

In the first place, fruit wrappers now found in the large fruit houses are very efficient, far more so than your device could possibly be, although we will admit they are not quite as simple. No glue (a very objectionable substance) is used in the commercial machines, but is employed in your device.

As for the screen door, this idea holds absolutely no hope of success. We do not advise a patent on either of the two systems.

GASOLINE LEVEL INDICATOR

(632) E. F. Ahlin, Leavenworth, Wash., submits a sketch and specifications of a dashboard gasoline level indicator in which a segmented rod is connected to magnets behind the dial located on the dash permitting the current to be progressively shifted to different coils. A carbon brush slidably mounted makes contact with the segments. This brush is located upon a suitable float.

A. There are many drawbacks to the device which you have submitted to us, and it is just as well to enumerate them here.

The space occupied is considerable in comparison to similar commercial articles. Continuous use of electric current is necessitated in order to operate the indicator. The system itself, both in the tank and on the dash-board, is very bulky.

Now, as to the indicator, you will note that there will necessarily be seven leads running to the dash-board signalling device in order to operate this properly.

Another bad feature is that the carbon brush in the tank itself is very liable not to make perfect contact. If a very firm contact is attempted, the float may not rise properly, in which case a false reading will be obtained. A spark may result in the tank, due to a sudden dropping or a sudden rising of the float and last, but not least, the resistance between the contacts changes greatly.

In view of these conditions, we could not advise a patent application.

ELECTRICAL HAMMER

(633) Wm. Dunnett, Manitoba, Canada, requests patent advice on an electrical hammer he claims to have constructed.

A. In view of the fact that details are lacking in your recent communication to us, we are unable to definitely assert whether or not a patent could be obtained on the automatic hammer which you have in mind. The idea seems very clever indeed, and if it works as well as you state, we advise that you get in touch with a reliable patent attorney.

FREE ENERGY MACHINE

(634) Gilbert Ernest, Gydney, C. B., intends to employ two magnets and two copper squares. The magnets are to lie between the squares. He reasons that the lines of force from the square outside (north magnet) would travel through the copper to the inside (south magnetic) pole and induce a current in the copper areas.

A. Your system would by no means develop electrical energy, not even in the slightest degree. Although as you state, there are magnetic lines of force cutting copper plates, these lines of force are steadily exerted, and therefore, if a galvanometer were connected to the leads as the magnetized iron cores are inserted into the coils a slight deflection of the galvanometer would indicate the production of a minute electrical current, but when these bar magnets are at rest there would be no current induced, in the galvanometer, inasmuch as your device is to remain at rest at all times the chances for its operation are nil.

It is manifestly impossible to build a permanent magnet having only one pole, that is, a unipolar magnet.

COMBINATION SAFETY RAZOR

(635) J. H. England, Greenwood, Miss., submits a sketch of combination safety razor brush and cream holder, and also a drawing of a flashlight casing.

A. We believe that the device is patentable and is an extremely good idea, particularly in view of the fact that you intend to incorporate with this, the ordinary style safety razors. Perhaps a small piston-like arrangement could be arranged on the back so that the device will be self contained, even

U.S. PATENTS

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to the water. Also as only a slight amount of water is necessary to moisten the beard sufficiently, in order to bring the soap to a lather, we believe it would be an improvement. We do not doubt that it is patentable and a profitable invention, if it is placed on the market at a reasonable fee.

In reference to your second device, we do not believe that it holds a very radical improvement over other torches, and although a fair sale might be had for a device of this nature, we doubt very much whether it would pay to go to the expense of patenting and financing the scheme.

CORK HEELS FOR SHOES

(636) H. J. Davis, Brooklyn, N. Y., asks our opinion on placing tooth powder in tablet form, and, also our advice regarding the use of cork heels for shoes.

A. We do see where you gain an advantage whatever in putting up tooth powder in tablet form, in that the tablet would first have to be softened or dissolved, which makes it rather wasteful.

Cork heels for shoes will not answer very well, in that the wear upon shoes is quite considerable. Cork is particularly susceptible to wear and breaks and cracks very easily. It does not fasten well to a heel, and a special construction would be required in order to grip it. Although cork does possess considerable shock absorbing quality, it would be manifestly impossible to employ it as a heel for shoes. If cork is to used inside of the shoe as a shock absorber, a patent could not be obtained upon the idea, in that it is already fully covered.

AUTOMOBILE CAMP TABLE

(637) Wm. Cossen, Brooklyn, N. Y., submits a design of an automobile with a table in the space in back of the front seats.

A. We do not believe that the application of a table to the rear of the seat of an automobile as you have designed would be of any great value, as when persons desire to camp out, they do not generally like to remain in the car in order to eat their lunch; an added inconvenience being that crumbs and other bits will fall into the car.

Secondly, large cars invariably have some mode of access into the rear compartments of the forward seats in which commodities etc., are kept. This would prevent the application of the table.

Thirdly, the changes necessitated in the car itself and the various size table required would make such method of procedure a great inconvenience and quite costly. It would therefore, be much better to use the small collapsible tables now on the market for purposes of this nature, hence, we do not believe that, even though a patent could be obtained on the device, it would prove of commercial value.

RAILROAD CROSSING SIGNALS

(638) J. R. Clemons, Davenport, Iowa, submits a suggestion for railroad crossing signals and requests our advice.

A. We do not believe that either the gates or the lighting arrangement for railroad crossings will be of any value whatever, as touring cars and automobiles have been known to bear down upon a railroad crossing in which the gates were down, red lights were displayed upon both sides, and in the center of the gate, and gongs were ringing intermittently, yet the tourists drove clear through the gate, smashing it to smithereens, and continued up the embankment on the opposite side.

Something must be done which will absolutely prevent an automobile from crossing a signal set against it, and which must not be too expensive. This device should also permit transients between the gates on either side to continue across the tracks, and clear the road. The gates should effectively prevent any further transients from crossing. Incidentally, the same system must apply to vehicles. Lights and signals are not satisfactory enough.

SCRIPT WRITING MACHINES

(639) H. A. Rader, Toronto, Ont., Canada, requests our opinion on a typewriting machine in which a pen or pencil faithfully reproduces ordinary script writing. Typewriter keys are to operate it and cams guide the movement of the pen.

A. Although there are many novel ideas in the recent scheme you submitted, we do not advise a patent upon the same.

People today prefer a typed letter to the hand-written one. A typed letter is more readable and looks much finer. In the second place, the regulation by cam control in your system would be rather difficult to obtain and because of continuous wearing, a constant regulation would have to be maintained. No matter how rugged you may make your system the frightful punishment given to our typewriters today would never be withstood by a design similar to yours. In the third place the completed design would give slow results. This is the most serious objection to the device and it cannot, in our opinion, be remedied.

In addition there have been several handwriting typewriters invented. These are found upon the open market today.

We would not advise a patent upon your system.

CAN YOU

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Automatic Brake Control for Motor Cars

By H. H. DUNN

(*Continued from page* 441)

rear of the car, and projects about eighteen or twenty inches beyond the chassis at either end.

A minimum pressure of 15 pounds applied to the contact bars pulls the outer ends of the goose-necks inward and completes an electrical contact which sets the brakes, cuts off the ignition current and starts the horn blowing. The cutting off of ignition, of course, assists in the braking of the car thru compression, and a series of experiments showed that this stoppage was completed in one-third the time, and less than one-half the distance required for a very skilled driver to perform the same operation with foot or hand brakes and his ignition cut-off. No attempt is made to claim anything for the invention when cars are running at speeds beyond 20 miles an hour, except to minimize results of collisions, and to reduce injuries to pedestrians, thru the resiliency of the contact bars or cables. Because of the almost immediate stopping of the cars, the danger of running over pedestrians, should they be struck with force enough to knock them down, is minimized, and, owing to the projecting position of the contact bars, the tendency is to carry the pedestrian on the bars and radiator, if the accident be serious, rather than to throw him to one side.

One of the most important uses claimed for the new device is in the protection of parked cars. The car equipped with the automatic brake and ignition control, if bumped by a car, either from behind or in front, automatically blows its own horn, and continues blowing it until the pressure is removed, thus warning the moving driver of the presence of the car, even during the absence of its owner or driver.

The device also can be used from the dash-board, and, by the mere pressure of a finger on a button, the car equipped with this device can be brought to a stop much more rapidly than by the application of hand or foot brakes, or even by the emergency brake.

Either feature, by an arrangement on the dash-board, can be eliminated. Thus, when the driver parks his car, he sets his brakes and cuts off all the automatic devices except the horn. When he is running, he can cut off the horn, if he so desires. On occasions when he wishes to eliminate the brake control, as when passing over brush-grown country roads, or leaving the road to pass another car or to strike out across country, he can cut off the entire device, the inner mechanism then riding on the brake rod, without any hindrance to the operation of hand or foot brakes or the horn.

"Combination" Prize Contest

(*Continued from page* 455)

lever, and then moves the pistol about until the light appears on the point of the object to be hit; when for instance, the bullseye on the target, or a vulnerable spot on a fleeing criminal, lies in the exact center of the circular spot of light the trigger is pulled. When the flashlight is properly attached to the pistol, as determined by firing a few trial shots, while checking up the alignment of the flashlight, deadly accuracy of fire becomes possible.

Safety razors are not the only money makers in the world, for manufacturers of *safety guards* to be used on the regular razors have sold thousands of them. Many men, as the reader perhaps already knows, do not take kindly to the safety razor and swear by the old-fashioned long blade razor,

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and so we have here the combination of two simple things—a razor and safety guard, which forms a very desirable combination instrument. In general, we may consider the ideal combination of these two separate parts as incorporated in the regular type safety razor.

For years, we have been pestered with messy tooth paste tubes and boxes which are forever falling on the floor behind the bath tub, but at last an American manufacturer has supplied a long suffering public with a very useful combination, in the form of a *tooth brush and tooth paste dispenser*. The tube of tooth paste is placed in the hollow handle of the tooth brush and is firmly retained there. When you wish to use the brush to cleanse your teeth, you simply push a button which opens the handle, you squeeze some paste out of an opening passing through the center of the handle, and it issues forth among the bristles. The handle is then closed, and the cleansing operation proceeded with. The manufacturer of this valuable toilet accessory may even go a little further and place a small combination or other type lock on the handle, so that anyone who choses cannot use the tooth brush.

Another combination instrument we show here is an *electric curling iron and comb*, either of which can be used separately when desired. Another picture shows a new *electric cigar lighter and flashlight* or trouble lamp, for use on automobiles. Another combination automobile novelty shown is a *parking light and mirror*.

There are numerous other combination utilities which we could cite, as for instance, a combined pencil and flashlight for taking notes in the dark; combined flashlight and lady's purse or vanity case; cigar lighter and ash trays; combined pencil or pen with rubber monogram or signature stamp which folds into a small compartment at the end of the pen or pencil, etc., etc.

We desire to see what our readers can suggest along these lines, and believe that there are plenty of new novelties to be devised *by joining two or more simple things together*. We, therefore, offer a series of prizes for the three best ideas on a combination appliance or utility. It should be practical above all things, and for the best idea a prize of $25.00 is offered; for the second best idea a prize of $15.00; and for the third best idea a prize of $10.00.

This contest closes October 15th at midnight, and contestants may send in more than one idea. No combination novelty sold in the shops at present should be copied of course, but what is wanted is something entirely new. In the event that two contestants submit the same idea or design, the same prize will be paid for both.

A model of the combination appliance or novelty is desirable, but a good clear photograph or else a drawing will do; make descriptions short and to the point to facilitate the work of the judges. Descriptions should be written on separate sheets, on one side of the paper, and typewritten descriptions are desirable, or else they should be written in ink. Try and keep the descriptions within 100 words.

Address all contributions to Editor "Combination Prize Contest" in care of this publication.

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The pet cocks of the engine provide an easy way of discovering just which spark plugs are clogged or defective.

Accordingly, if the engine is provided with pet cocks, the missing cylinder may be found by opening the cocks one at a time and noting which cylinder is not firing. Flame will be observed at all cocks except at the one that is missing, and it is probable that if a new spark plug is placed here the trouble will be cured at once.

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Gas Producer for Autos

By E. H LÉMONON

(*Continued from page* 446)

seat. The motor lorry is an ordinary La Buire, which develops 20 H. P when running on gasoline. The chief characteristic of the Vierzon system is the fact that the generator is designed to burn any kind of wood débris; and needs no water.

A quantity of kindling is thrown in the funnel, and when it is well alight the remainder of the cylinder is filled with wood chips, etc. The cover of the funnel is then shut, and the handles which will be noticed at the lower end of the generator are turned to cut off air. A small hand fan blower will also be observed, the purpose of which is to assist in starting the fire, or in resuscitating it subsequently, if necessary. There is a similar fan on the other side of the cab, but this is installed to draw the gas around from the generator to the motor before starting the latter on gas.

Between the generator and the engine there is nothing but a triple range of pipes to cool the gas, these pipes being fitted snugly to the frame of the chassis. The complete weight of the whole equipment fully charged is stated to be between eight and nine hundred pounds. This includes the special branch to the engine, which is provided with a three-way cock, controlled from the dash, and a separate air inlet so that the motor may be run on gasoline only, gasoline and producer gas, or the latter alone.

The La Buire engine, on which the trial alluded to was carried out, has four cylinders of 3.6 inches bore and 6.4 inches stroke. The reduction of power when the engine is running on the "poor gas" (the French name of producer gas) alone is about 40 per cent., that is to say, the engine gives from 60 to 65 per cent. of the power obtained on gasoline.

How I Built a Small "Speed Camera"

By FRANK M. BLACKWELL

(*Continued from page* 460)

"33". As "32" is lifted it releases the lug on gear "29" ("30" of Fig. 7). The downward pull of the curtain spring causes gear "28" to revolve and, in turn, gear "29" which carries the lug "30". As "32" has been lifted to release "30", "33" has been raised into position to stop "30" as the revolving gear "29" brings it around. Thus is an opening allowed to pass the lens and an exposure made.

Then, as pressure is removed at "14" at the end of the exposure, "33' drops downward and allows the lug "30" to move forward the fraction of an inch against "32" again. You are now ready for another exposure, or for re-winding of the curtain, as desired. It is readily seen that the small gear "35" causes the safety door to rise simultaneously with the making of the exposure. "36" are small springs which cause the bars "31 and 34" to return to their normal positions when the pressure at "14" is removed. "37", a small ratchet, holds the curtain roller spring attached to the shaft "13" at the desired tension. "19", a small spring holds the ratchet "37" in position against the shaft "13".

Fig 7. Shows the camera with the lug "30" brought into view. This lug, when released by the lug "32", on the back of the bar "31", whirls around with the gear "29" until stopped by the lug "33" which is also on the back of bar "31". This action allows the desired opening in the curtain shutter to pass the lens, thus making the exposure. "17" is the lens of, preferably, 75 mm focal length. "16" is the safety door covering the lens and which is lifted by the same pressure which releases the shutter. "38" is a handle for the carrying of the camera.

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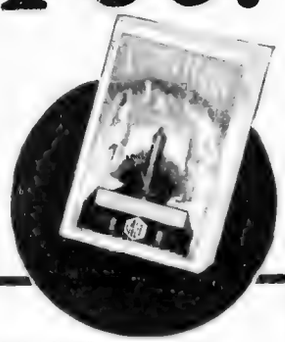

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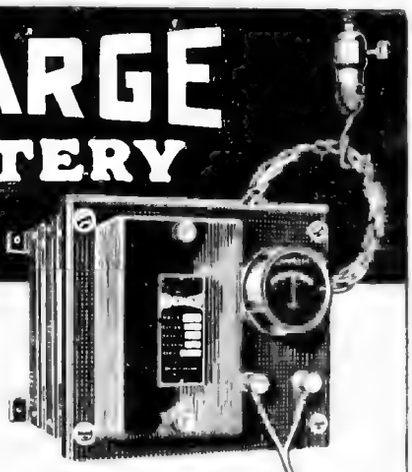

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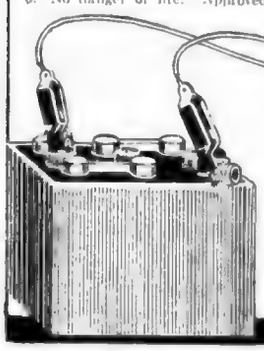

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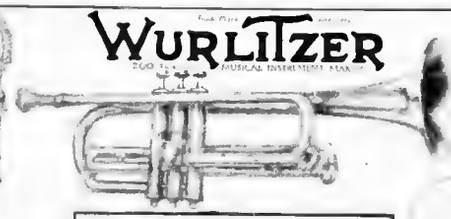

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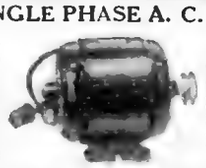

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Analysis of the Kiss

By JOSEPH H. KRAUS

(*Continued from page* 428)

in 10,000 cases among women fell between 105 and 119 millimeters, whereas fifty per cent of the men's readings fell between 115 and 137 millimeters.

The effect of a kiss on the sphygmomanometer was made in tests by the writer in the editorial offices of this magazine; a sphygmograph was also used.

The sphygmomanometer is an instrument designed for reading blood pressures. It consists of a compression bag which encircles the arm, a small air pump and a scale graduated to register in millimeters. Air is pumped into the compression bag placed around the arm, until the pulse beat is obliterated. In placing the sphygmograph upon the same wrist, it is possible to determine this point of obliteration, at the same time securing a record thereof.

The sphygmograph is a small clockwork device, in which a tiny knob presses upon the artery. This knob rising and falling with every beat, amplifies the record thru a system of levers, and actuates a needle which visibly records the beat on a blackened paper tape. This tape, previous to the operation, is covered with soot.

Very interesting are the results obtained. Thus the instruments strapped to a man, as shown in Fig. 2, gave a normal blood pressure of 130 millimeters. One long inspiring kiss and the pulse quickened perceptibly, as shown in the record. The blood pressure rose to 160, before evidence of the pulse beat at the wrist was obliterated. This is determined, of course, by pumping air into the compression sleeve of the sphygmomanometer and taking the reading on the dial or mercuric column. There was no doubt that the kiss was real, the meters indicating that this was so.

The same instruments attached to one of the fairer sex did not verify Kipling's, "The female of the species is more deadly than the male." Here the sphygmomanometer indicated a normal blood pressure of 100 millimeters. The kiss was not a half of one per cent kind, as the blood pressure rose to 122, and the pulse beat likewise quickened. The record in Fig. 3 gives the results obtained by the sphygmograph.

Of course there are dozens of varieties of kisses. We wonder what the meters would record in the case of a park bench in springtime, with full moon encouragement, but let us stop our imagination from traveling too far.

In the near future, we will see scales graduated in dollars and cents, so that at fairs, where kisses are being sold, the purchaser of these delectable vintages of youth will pay for what he gets.

(*Instruments Courtesy of George Tieman & Co., Staff Photos.*)

The Simplest Radio Outfit Contest

(*Continued from page* 471)

to be connected up as shown in the diagram. All five records are held together by a brass bolt and nut which also acts as a binding post. A 75-ohm telephone receiver is best purchased. Good results can be had with even the old style type, and the cheaper types can be greatly improved by using a diafram cut from the iron frame of an empty film pack case. Signals inaudible using an ordinary diafram can be clearly heard this way. For near-by radiophone stations a simple loud talker can be constructed from a child's tin horn mounted on top of the phone.

Using a single No. 18 bell wire supported between smoke stacks 150 feet apart, time

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If we gave the name of the manufacturer of this premier line of beautifying toilet articles, you would recognize it at once and be amazed. For business reasons, the name of the concern will not be published for a month or so, but the plan is herewith briefly set forth

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If the lady who reads this wishes to add to her income and get her toilet requisites free as well, she can earn from $10.00 to $50.00 a week, depending on the population of the community in which she resides, and all she need do is to distribute the literature of the manufacturer in person or by mail to women in the place where she lives.

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7x18"	6⅛"	17⅛"	10"	C670	3.50
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signals are clearly received in New York City from N.A.A. (Arlington, Va.). With a single No. 18 bell wire, 40 feet long, all radio jazz, opera, news and retransmitted time signals can be heard over at least 300 miles, using a 500-ohm phone and all stations within six or seven miles come in all over the room using the tin horn as a loud speaker.

At a New Year's party I connected this set to a piano and a gas jet and everyone heard W.J.Z. wish all listeners a "Happy, Happy New Year" at midnight above all the din and blowing of sirens outside.

As this set works so ideally and as the only item that must be bought is the phone and galena and perhaps the wire, and as the cost, even if all parts including the records were purchased, would not be over $2.75 at, the most, I think it should be well worth any one's time to make.

Cost if all parts were bought:	
1 75-ohm receiver	$1.00
¼ lb. No. 28 S.C.C. wire	.37
5 phonograph records, 5 inch size, @ 10c	.50
1 rotary switch	.45
Bolts and nuts	.20
½ lb. bell wire, No. 18, for antenna	.25
	$2.77
Cost if only receiver, etc., are bought:	
1 receiver	$1.00
¼ lb. No. 28 S.C.C. wire	.37
½ lb. bell wire, No. 18, for antenna	.25
	$1.62

Book Review

ARISE AMERICA. By Francis R. Hoyt, M. S. A. E., A. M. E. Fully illustrated. Cloth covers, size 5½" x 8½", 48 pages. Published by Francis R. Hoyt, New York, N. Y.

A plea for the development of the lighter-than-air craft is the keynote to this book, the idea being presumably that America is to rise into the air, and do things when she gets there The book depicts the need for preparation for war in the air. It gives illustrations of what has been done in the development of the larger kind of dirigibles. A frontispiece shows ruin wrought in Paris by a Zeppelin raid. It is certainly a very hard thing to say how far preparedness for war should go. The old theory was that to prevent war we should prepare for it The Germans, however, prepared for war and that did not prevent their incursions east, west and south, into the surrounding countries, while little Switzerland, whose small population made her preparations for war trivial, was spared from the infliction. Of course the German mind is to be reckoned with, but as war is now carried on, preparing for it in time of peace will involve confiscatory taxation. To the north of the United States is Canada, with a 3,000-mile frontier bordering said United States; she is not prepared to resist our attack, she doesn't propose to attack us, and no American citizen has any but the friendliest feelings toward her. If Canada and the United States, both unprepared for war against each other, without frontier forts or defenses, can live in perfect amity, and have lived so for over a century, it is hard to see why other nations cannot follow the good example.

PRACTICAL GUIDE FOR NOTARIES PUBLIC AND COMMISSIONERS OF DEEDS. By Eugene B. Schwartz. Revised edition. Cloth covers, size 5" x 7", 101 pages. Published by Cooper Publishing Co., New York City.

There is hardly any need to review this book as its title fully describes it. Its 101 pages of text, with a very good index quite completely tell the story of the notary's work. It is of convenient pocket size, so that it can literally be the notary's *vade mecum*.

THE CURE OF IMPERFECT SIGHT BY TREATMENT WITHOUT GLASSES. By W. H. Bates, M. D. Cloth covers, size 5½" x 8", 313 pages. Published by Central Fixation Publishing Co., New York, N. Y

Dr. Bates has won considerable renown, as being an oculist who is opposed to glasses. To one who does not wear them it appears a sort of slavery to be dependent on eye-glasses for the use of the eyes. The very man who wears glasses, who carries with him two pairs of glasses, or perhaps wears constantly his bi-focals, will exercise his muscles in his gymnasium day after y in violent exercise with Indian clubs, medi-

(*Continued on page* 513)

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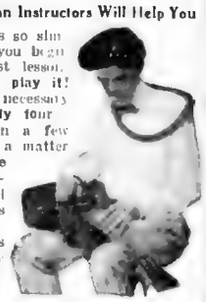

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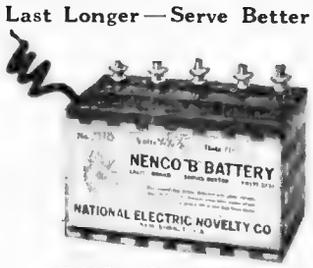

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Who Discovered Radio?

By A. P. PECK

(*Continued from page 465*)

direct current, would absolutely and necessarily prevent the exhibition of electrical polarity, as exhibited in the motion of the electroscopes, galvanometers, and of similar instruments."

One of the reasons why Edison believed that he had discovered a new force, was because the induced electrical current did not affect frogs' legs in the same way as electricity was demonstrated to do by Galvani and because it did not affect iodized paper, as electrical currents of a definite polarity will do. This of course, was because the polarity of the current changed so rapidly, that a positive motion in either direction, that is, negative or positive, was impossible. This reversing of current is shown by the fact that when a direct current is set up in a coil, and suddenly broken, an inverse current is induced by the iron core in the opposite direction in order to re-establish the electrical equilibrium. In other words, the current induced in the secondary of a spark coil, when the circuit is closed, will be opposite to that induced when the circuit is opened.

While Professors Houston and Thomson were performing the above experiments, they noticed that the instrument of the telegraph line running through the laboratory, gave forth a slight "clinking" sound when the induction coil was in operation. The other end of this telegraph line was in a building about 500 feet away. They telegraphed to the operator at the other end and asked him to stand by and note any disturbances in his apparatus. After they had operated the induction coil again, the operator telegraphed back that a slight "tinkling" sound had been produced by his sounder. This proved that the results were not merely local. The production of the sound was probably due to a rapid succession of molecular changes produced in the wire by the sudden reversion of its electrical status.

During these experiments in December 1875, the two scientists went somewhat further with their investigations.[3] They placed a tin can on top of a glass jar, the latter being for insulation, and connected it to one pole of a spark gap connected across the secondary of a 6-inch induction coil. The other side of the gap was connected to a water pipe. Two small graphite rods were sharply pointed and placed in a black wooden box with their ends almost touching. A large brass ball was attached to a rod, the other end of which held one of the pointed graphite rods. The other rod was arranged so as to be adjustable. This detector apparatus was the same as used by Edison and is shown in the accompanying illustration.

Now, when the coil was operated, a tiny spark was observed to pass between the two pencil points. This was an indication of the results of electrical waves, transmitted through the ether.

The receiving apparatus was used not only in the same room, with the transmitter, but was carried from floor to floor of the High School building, results being obtained in each instance, *even when more than 90 feet of space and five brick walls separated the two sets of apparatus.* In this work, Prof. Thomson saw the germ of a system for signaling through space without wires.

During the course of his experiments, Edison found that when the box containing the two pointed rods was brought near a telegraph sounder while in operation, a spark showed when the electro-magnetic circuit was opened or closed by the key. No metallic connection was made between the rods and the sounder.

(*Continued on page 506*)

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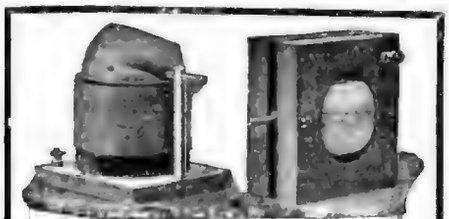

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Who Discovered Radio?

(*Continued from page* 504)

The waves produced in these experiments were thought to be similar to those announced in the mathemetical theory of Maxwell.

However, Houston and Thomson did not pursue this theory further, and it was not recalled until the announcement of the discovery of electrical waves by Hertz in 1887, twelve years later.

At this time Hertz came forth with the announcement that he had succeeded in transmitting electrical waves without the use of wires, and upon this theory, in 1896, Marconi started to work with the results we all know of. Marconi was also aided by the discovery of Calzecchi Onesti, who in 1887 observed that certain metal filings cohered when affected by the discharge of a Leyden jar or induction coil. This, of course, was the forerunner of Marconi's first practical receiving set, and was improved upon by Branly who invented the coherer.

Working with these two discoveries, Marconi produced more and more successful apparatus, and in 1901 succeeded in transmitting signals across the Atlantic Ocean. Then came still more sensitive and efficient apparatus, such as the crystal detector for reception, and improved transformers for transmission. Later, came the audion bulb, which has at the present time, practically revolutionized radio transmission and reception and made possible the wide-spread use of radio-telephony we know to-day.

[1]See Journal Franklin Institute for June, 1871.
[2]See Journal Franklin Institute for January, 1876.
[3]See General Electric Review, May, 1915.

Five Stage Amplifier on 110 Volts A. C

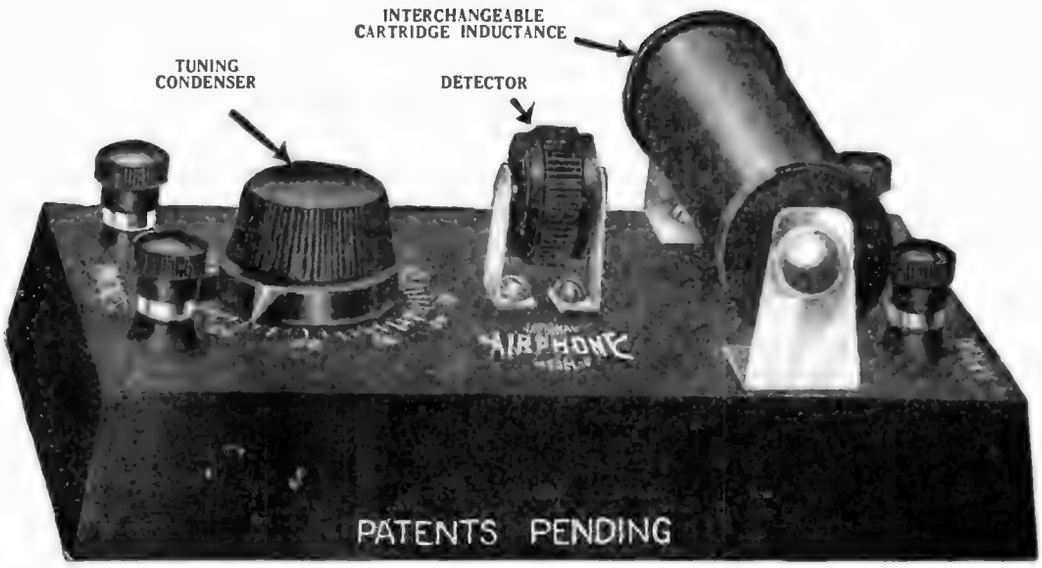
(*Continued from page* 469)

by connecting a suitable sized spark coil secondary unit and a suitable primary winding on a closed soft iron core formed of wire or sheets. For the 300-volt transformer an iron core audio-frequency transformer may sometimes be used, if the primary is sufficiently heavy to stand 110 volts, 60 cycle A. C. A choke coil may have to be used in series with it to prevent burning it out, and of course this can be determined by a little experimenting. The choke coil used in series with the Magnavox field winding may comprise 1,200 to 1,500 turns of No. 24 insulated magnet wire, wound on a laminated sheet iron core one-half inch square by 5 inches long. A large condenser connected in shunt to the choke coil and field coil of the loud-talker, would no doubt prove efficacious. This could very well be tried until the best capacity is obtained.

Data is given below, as well as diagram in Fig. 2, of a 100-watt transformer suitable for supplying all of the A. C. necessary in operating the five-stage V. T. amplifier here described.

This 100-watt transformer has a laminated sheet iron core measuring 12 inches long by 6 inches wide over all, the cross-section dimensions of the legs being 1 inch by 1 inch. Stove pipe iron cut in strips to the proper dimensions may be used in building this transformer, or possibly a core may be purchased from an electric shop or manufacturer of transformers, but the exact dimensions here given do not have to be followed, so long as the ratio between the turns on the primary or 110-volt winding, and the successive secondary windings, are maintained correctly so as to give the necessary A. C. potentials at the secondary terminals.

(*Continued on page* 508)



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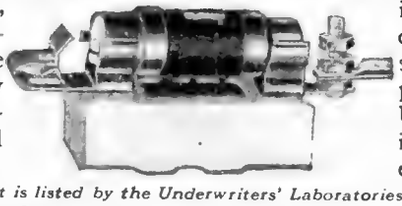

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Five Stage Amplifier on 110 Volts A. C.

(*Continued from page* 506)

The two long legs of the transformer core should be insulated with four layers of oiled linen, or else ordinary insulating tape. The primary winding comprises 700 turns, or about seven layers of No. 15 D. C. C. copper magnet wire. The secondary windings are wound between fiber partitions on the second long core leg, as indicated. The lengths of the secondary windings are proportioned, so as to give each coil a reasonable share of the total winding space. The first coil, S-1, gives 8 volts and 2 amperes, for the rectifier tube H, in Fig. 1, and comprises fifty turns of No. 16 D. C. C. magnet wire, wound in, say, five layers of ten turns each. The second coil, S-2, yielding 8 volts and about 6 amperes, for lighting the filaments of the five amplifying tubes, is wound with fifty turns of No. 12 or No. 11 D. C. C. magnet wire in, say, five layers of ten turns each. The third secondary coil, S-3, will give 4 volts and 2 amperes for the filament of the Tungar rectifier tube G, in Fig. 1, and is wound with twenty-five turns of No. 16 D. C. C. magnet wire in, say, four layers.

The largest secondary winding, S-4, that giving 300 to 330 volts, is wound with a total of 2,100 turns of No. 36 D. C. C. magnet wire, leaving out taps during the winding at 700 turns and 1,400 turns, which will permit connecting to 100 volt and 200 volt steps on the coil.

One may redesign the secondary units to suit himself quite easily now that the general design is worked out for this given case, and the iron core dimensions and primary data is known. In designing any other type of secondary windings, allow 1,000 circular mils cross-sectional area per ampere; to determine the number of secondary turns in any coil, multiply the secondary voltage by the number of primary turns and divide by the primary voltage. Thus to design a four-volt secondary we multiply four times seven hundred, the number of turns in the primary, and divide by 110, the primary potential, which gives twenty-five turns as the proper number for a secondary coil to yield four volts. The 100-watt transformer core and primary here given will be sufficient for any five or six-tube amplifier set which the average radio enthusiast may operate.

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page* 470)

These are very similar from day to day and therefore afford excellent practice. When you get off the track a familiar word or phrase comes along and puts you back again.

Lastly comes the Navy press. While this deals with the news of the day, which of course is never twice alike, the same names and phrases are repeated more often than one would suppose. A newspaper reader quickly learns to recognize them and, the matter being dotted with familiar bits, the unfamiliar words give less and less trouble.

It is necessary, of course, to have a copy of the International Morse Code somewhere where you can see it. This can be found in most radio books and in the Boy Scout Handbook. Several letters are different from those used by land line telegraph operators.

Most learners begin by trying to commit the code to memory: "a" is dot dash, "b" is dash three dots, and so on. That is the

(*Continued on page* 510)

WONDERFUL NEW INVENTION BRINGS RADIO RECEPTION OVER YOUR ELECTRIC LIGHT WIRES

Super-Antenna

THIS wonderful unit has been developed by the country's foremost engineers, making possible radio vacuum tube reception over your electric lighting circuits. No power current is used when operating a "Super-Antenna." It operates on any electrical circuit from 32 to 120 volts, D.C. or A.C. Light plug can be turned either "ON" or "OFF."

The "Super-Antenna" is shock proof, will not blow fuses, and will not damage a receiving set in any way. During the many months of development of this unit, all practical circuits were protected. Beware of imitations. They are expensive to experiment with.

No Outside Aerial Necessary

This unit does away with the dangers of stringing antenna over power and lighting wires, where great danger results when antenna touches live wires caused by storms, etc. The "Super-Antenna" eliminates all troubles and dangers incident to the erection of the antenna. Most convenient for using your vacuum tube receiving set anywhere. You just insert plug in any electric light socket and connect binding post to your receiving set.

TESTED BY LARGEST EXPERIMENTAL STATIONS

The "Super-Antenna" has been tested by many Radio Experimental Stations and found to give marvelous results. Stations twelve hundred miles distant may be readily copied with the ordinary installation, and in the majority of circuits it tends to reduce static effects.

Safe--Efficient --Convenient

NO POWER CURRENT NECESSARY
ELIMINATES DANGERS
SHOCK PROOF
WILL NOT DAMAGE RECEIVING SET
WILL NOT BLOW FUSES

ORDER TODAY $2.80

The demand for this "Super-Antenna" is taxing our supply to the limit, so get your order in early. Dealers everywhere are stocking them. If your Radio Dealer cannot supply you with the "Super-Antenna" order direct and send us his name.

Enclose Check or Money Order. West of Rockies $3.00, Canada $3.70.

Dealers and Jobbers Be first in your territory to stock this wonderful unit.

LOOK FOR ORIGINAL
BEWARE OF IMITATIONS

SUPER-ANTENNA COMPANY, Dept. 29, Quincy, Ill.

The RADIOGEM

(Parents Pending)

$1 Receiving Set—The Simplest Radio Outfit Made—Yet as Practical as the Most Expensive!

You need know absolutely nothing about wireless to operate and enjoy the RADIOGEM. It is so sturdy, so simply constructed that it is small wonder radio *engineers who have tested* it have pronounced the RADIOGEM a brilliant achievement. The RADIOGEM is a crystal radio receiving set for everyone at a price anyone can afford.

Why The RADIOGEM Can Be Sold For Only $1

Here's the secret: The RADIOGEM Construction eliminates all unnecessary trimmings, cabinets and the like, which do not play any part in the operation of a set. You receive the RADIOGEM unassembled, together with a clearly written instruction book, which shows you how to quickly and easily construct the set, using only your hands and a scissor. The outfit comprises all the necessary wire, contact points, detector mineral, tube on which to wind the coil, etc., etc. The instruction book explains simply and completely the principles of radio and its graphic illustrations make the assembling of the RADIOGEM real fun. Remember the RADIOGEM is a proven, practical radio receiving set and will do anything the most expensive crystal set will do.

The RADIOGEM is the Prize Winner of the Age

Out of hundreds of radio models submitted recently in a great nation-wide contest, radio engineers, the judges, unanimously chose the RADIOGEM as the winner—the simplest radio-receiving set made! And the RADIOGEM costs you nothing to operate; no form of local electricity is required.

DEALERS The RADIOGEM is the wonder item of the radio age. It will storm the country, for the RADIOGEM'S price is so low everyone is able to buy one. Write immediately for full particulars before that shop across the street beats you to it

Hear the programs of the Broadcasting Stations on the RADIOGEM

Receives up to 20 Miles

The RADIOGEM CORPORATION
42-S HUDSON STREET
NEW YORK CITY

Take One to Camp or on That Motor Trip

$1
Without Phone or Aerial

U.S. RADIO Co
OF PENNSYLVANIA INC.

Insist on Getting THE BEST CRYSTALS ON THE MARKET

U. S. EAGLE GALENA, 25 Cents
U. S. EAGLE GOLDENA, 35 Cents

MOUNTED U. S. EAGLE GALENA AND GOLDENA, 2-in-1, 50 Cents

Patent Applied

Each U. S. Eagle Crystal is Packed with the following guarantee

GUARANTEE

We guarantee that each U. S. EAGLE crystal is tested and sensitive. If any U. S. EAGLE crystal is not satisfactory, return this slip with your address, and the address of your dealer direct to us, and receive another crystal free of charge by return mail. The U. S. EAGLE trademark is your protection.

U. S. RADIO OF PENNA., Inc.
Distributors of Domestic and Imported
Radio Telegraph and Telephone Apparatus
Cor. FERRY & DIAMOND STS., PITTSBURGH, PA.

Name _____
Address _____
Dealer's Name _____
Address _____

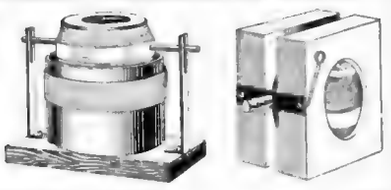
Attractive proposition for dealers and jobbers.
EVERYTHING IN RADIO SUPPLIES SEND 10 CENTS FOR CATALOGUE

U. S. RADIO CO. of PENNA., Inc.
Distributors and Manufacturers of Radio Apparatus
Corner of Ferry and Diamond Streets
Pittsburgh, Pa., U. S. A.

10c. Charges RADIO & AUTO Batteries At Home With An F-F Booster

Which is a Full Wave Automatic Magnetic Rectifier for 105-125 Volt 60 Cycle A. C. A Complete Compact Self Contained Conveniently Portable Automatic Charging Unit. Adjustable Renewable Infusible Carbon Electrodes Rectify Current Uninterruptedly. Leave Battery in Car. Screw Plug in Socket; Snap Booster Clips on Battery Terminals. Turn Switch, lock garage door, and Your Battery will be Charged in the Morning. Is It Not Gratifying to Feel Your Batteries are Ready for All Radio phone Music & News? AMMETER eliminates All Guess Work. No Skill is Required. They last a Lifetime. Starting Car Quick, requires Fewer New Batteries. Booster thus Saves more than its Cost. Don't think Your Battery is dead & worn out simply because it will not start Your Car. Buy a Booster & Fill it With Life. It Also Saves You 75ca Charge. POPULAR PRICES: Type 6 charges A 6 volt Battery at 6 amperes $15 Type 12 charges 12 volt Battery at 5 amp $15 Type B charges 2 to 120 volt Radio B batteries $15 Type A-B charges Both A & B batteries $20 Type 166 charges 6 volt Battery 12 amps $24 Type 1612 charges 12 volt Battery 7 amps $24 Type 1626 is a Combination of Types 166 & 1612 & Charges Both 6 & 12 volt Batteries $36 The Larger Types are recommended for heavy Batteries, or where time is limited. Shipping Weights Complete with AMMETER & BATTERY CLIPS, 11 to 15 lbs. Order from Your Dealer, or Mail Check for Prompt Express Shipment; include Postage & Insurance Charges for Parcel Post Shipment, or Write us to Ship Type desired C.O.D. F-F FULL WAVE ROTARY RECTIFIER For GROUP CHARGING Automatic 12 Battery 8 Ampere Size $135. FREE Descriptive ROTARY Bulletin 12A. Order Now or Write Immediately for FREE Descriptive BOOSTER Bulletin 12.

France Manufacturing Co., General OFFICES & WORKS, CLEVELAND, OHIO, U. S. A.
Canadian Representative: Battery Service & Sales Co., Hamilton, Ontario, Canada.



VARIOMETERS - - - - $5.00
VARIOCOUPLERS - - - $4.50
SHIPPED IMMEDIATELY FROM STOCK

Our low manufacturing costs enable us to make these prices. Best workmanship and material are used. These instruments are perfect in construction and design. All parts accurate. Easily mounted on panel. Coupler primary has seven taps. Effective tuning range 180 to 600 meters. Make your own highly efficient regenerative set with a loose coupler, two variometers and necessary parts at a very low cost.

Radio panels cut to order, smooth sawed edges. We cut them exactly to size and ship the same day your order is received. ¼" thick $0.01½ per square inch—for more information on radio panels see our ad in the wireless column of opportunity ad-lets.

RADIO INSTRUMENT & PANEL CO.
26 N. Des Plaines Street, CHICAGO, ILLINOIS

VULCANO
RADIO TORCH

Self-Heating Soldering Iron, blow torch combination.

Postpaid for
$2.50

Latest Device
BIG HIT

with electricians and mechanics. Points on Radio soldering FREE. Certificate of honorable mention from Radio Inst. of the N. Y. Evening Mail.

AGENTS WANTED

NATIONAL RADIO SALES CO.
32s UNION SQ., N. Y. C.

Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page 508*)

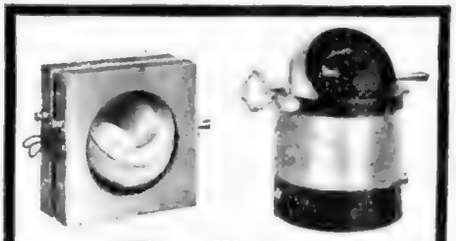
analytical method in modern instruction. If the pedagogues could get hold of us at birth, instead of at five or six years of age, our first lesson might be: one head plus two arms plus one lap plus certain individual peculiarities equals my mother, and the mention of jam might not produce any more enthusiastic response than the suggestion of castor oil—not at first. I learned that way but I believe there is an easier method. Code messages are received by hearing, not by seeing, dots and dashes. A person who has learned the code as printed usually has to go through a long process when he begins to hear it. He hears "dot dash", says to himself "dot dash", thinks of "dot dash" on the card and finally puts down "a". This takes time and before he gets it all done the next letter comes, he tries to think of two things at once and gets stalled. I believe it is better to listen until the ear clearly distinguishes dots, dashes and spaces. As soon as the ear can distinguish two dots from three and three dots from a dot and two dashes, write them as dots, dashes and spaces and translate them at your leisure.

Some peculiar experiences are encountered in learning code. They discourage many but they are not discouraging when they are understood. The beginner catches a few words of a message, then suddenly he finds that he cannot grasp any more of it. That usually is due to the fact that the ear and its connections are easily tired. There is little use in trying to screw the attention up to the sticking point. A few minutes of rest and relaxation are necessary, that is all. Few beginners can do good work for more than fifteen minutes at a time and more find that five minutes of concentration are enough.

This condition may last a long time while the muscles, nerves and brain fibers involved are forming the habits necessary to continuous work. In four months of code instruction at a good school I began by passing a fifteen-words-per-minute test, worked one or two hours per evening three or four evenings a week, rose one evening to twenty-seven words a minute, then had the greatest difficulty in passing a Government examination at twelve words a minute. Always, when anything happened to keep me from working at code for a week or longer, I found that I could copy faster, when I began again. These experiences are similar to those of other persons whom I know and I believe they are typical.

While the speed of transmission should be fairly within the pupil's ability, the teacher who watches to see that the pupil has put down one letter before he sends the next is delaying progress. The radio operator seldom knows whether the man at the other end is getting him or not until the receiver reports back at the end of the message or group of messages. From the beginning the learner should work as though handling traffic under actual operating conditions. The worst possible practice is that in which one beginner transmits for another. It is like talking baby talk in order to learn oratory. A skilled operator's sending is as rhythmical as music and that is what a beginner should hear always.

The advertisements speak of short-cuts in learning the code. Enthusiastic letters from those who have purchased short-cut systems seem to indicate that they are more than satisfied. It seems improbable to me, because I have never met a person who did it: that anyone could learn code through the eye and then from the first effort copy it as received through the ear. If it is to be learned through the eye there is no reason to



Ra-Fone

Variometer $3.80

Stators 4½ inches square, rotors 3½ inches. Double cotton covered windings, No. 22 wire set in insulating varnish. Flexible leads to 3½-inch secondary. Clear insulating varnish finish. Mounts flat to panel with 2 countersunk screws.

Vario-Coupler $3.80

Primary wound on 4-inch black dielectric tube with 9 single taps and 8 nine-turn taps. Taps are soldered on brass strips and turned to allow easy soldering connection for user. Rotor 3 11/16 inches in diameter, making very close coupling with primary. Rotor finished with flexible leads through hollow rotor shaft. Primary and secondary both wound with No. 22 green silk covered copper wire 44 turns on rotor, 80 turns on primary. Finished with clear insulating varnish.

Both guaranteed to be of very best material and workmanship and to receive perfectly up to 500 meters when properly installed. Immediate shipment by parcel post on receipt of price. Satisfaction guaranteed or money back.

Re-Tone Electric Co. 919 Park Place West DETROIT, MICHIGAN

Our Genuine Skinderviken Transmitter Button

RADIO TYPE for Loud Talkers. Experiments. Sound Transmission.

Send for diagrams, free

Price $1.00 postpaid with instructions

K. Electric Co.

15 Park Row New York

FROST RADIO LEADERS

Frost-Fones	Frost-Radio Protector
Frost-Radio Extension Cord and Plug	Cunningham Vacuum Tubes
Frost-Radio Receiving Transformers	Frost-Radio Improved Plugs and Jacks

Remler Radio Apparatus

Inquire of your Local Dealer

Like Postage Stamps Used Everywhere — FROST RADIO

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NATIONAL FACTORY DISTRIBUTORS TO THE ELECTRICAL-RADIO JOBBER

154 W. LAKE ST. CHICAGO, ILL.

S-C LOUD SPEAKER HORN

Delivered at any door in U. S. for **$7.50**

Largest value on the market

22½ in. high; 8⅜-in. bell

Made of soft brass of remarkable tonal quality, on correct, tested acoustic principles. Takes any radio receiver in universal receptacle. Handsome gold bronze finish, lacquered. Counterweight prevents tipping.

In the same high quality with low prices: Variometers, Variocouplers, Variable Condensers, Amplifying Transformers and other radio parts. Pink-a-Tone Sets, $25.

Ask for Bulletin R.

S-C PRODUCTS COMPANY

1266 Nicholas Bldg. TOLEDO, OHIO

doubt that any good system, based on the association of ideas, will shorten the time required, but I never knew a person to get up to commercial speed without patient plugging.

There are machines that will send code very perfectly at any desired speed. I have tried them. They rattle me for no apparent reason except that they are machines. I used one for three months and I do not know yet what was on the disc, except a few that I read with my eyes. This is a personal difficulty and I believe it is not encountered by any large proportion of learners.

In a good radio school a beginner has the advantage of listening under supervision to an instructor's transmission and actual radio traffic as well, plus the uplift of a teacher's inspiration. I met a teacher named Nicholls who challenges the admiration and best efforts of his pupils. He tilts back in his chair and dictates a string of unconnected letters, figures and punctuation marks for fifteen or twenty minutes. He has no copy of what he dictates. That type of pupil whose only object is to "get by" puts down any old thing, thinking that teacher will not know the difference. Then Mr. Nicholls repeats the whole string from memory without a miss while the pupils check up each other's papers. It is a stunt, and the pedagogy books that I have seen make no mention of such methods, but I'll wager that it gets results faster than the most orthodox procedure. It is an old saying among pupils that "those who can, do; those who can't, teach." In selecting a radio teacher any sensible man tries to find one who shows a mastery of details that can only be acquired by practical experience.

The man who finds code practice dull work is devoid of sporting blood. There is drudgery in all work. You cannot learn to play the piano, drive a car, or shoot a good game of billiards by making amusement the first consideration. Passive entertainment is the dullest occupation in the world to any man who ever succeeded in anything. And the best fun in the world is to work like yeast and find that each day you can do something that you could not accomplish the day before.

Success in code reception sometimes seems to arrive suddenly. After months in which you alternate between hope and despair you put on the phones some day and discover that they are talking to you. You no longer think dots and dashes but words and sentences. You recognize a lot of stations by their tone and style without waiting for them to sign off. An operator opens up who used to lose you inside of a sentence or two. You shoot him on the wing. He can't get away from you. If he hesitates an instant, as the best of them do at times, you feel like saying to him, as the Congressional stenographer did to the rapid-fire senator who asked if he was getting him all right: "Go right ahead, sir, I am ten words ahead of you!"

MINE RADIO SUGGESTED

A new use for the wireless telephone in connection with mine-safety and mine-rescue work is proposed by the United States Bureau of Mines. The suggestion has been made that the rescue cars and trains stationed at various points throughout mining regions be equipped with apparatus, and that high power apparatus at the bureau's safety stations and experimental laboratories in the regions be installed to broadcast hurry-up messages in case of mine disaster.

Aerials have been successfully installed on railroad cars in Germany, it is pointed out, and the bureau's rescue and training cars could easily be so equipped. In this way, it is said, not only could warnings and calls for aid be sent without delay to those points best equipped to offer aid, but mine-safety programs and other instructions could also be broadcasted.

Putting the "howler" to sleep

THERE'S more than one "howler" to put to sleep these days. Your radio set can put on the greatest squalling and howling demonstration you ever dreamed of. The surest way to stop this howling and keep it peaceful is to add an Acme *Audio* Frequency Amplifying Transformer.

Most any amplifying transformer can magnify the incoming sounds but it also amplifies the howling and distortion of stray fields in the circuit. Acme Transformers with their specially constructed iron cores and coils eliminate this disagreeable feature—and it only takes five dollars to buy one.

Acme assures your receiving a large volume of sound that possesses the natural tones so lacking in the ordinary receiving set. Then, too, you will want the Acme *Radio* Frequency Transformer which costs the same as the Acme *Audio* Frequency Transformer. It can be used on both crystal detector and vacuum tube sets. It greatly increases the range of either.

You can buy either transformer at your nearest radio store or write the Acme Apparatus Company (pioneer transformer and radio engineers and manufacturers), Cambridge, Massachusetts, U. S. A. (New York Sales Office, 1270 Broadway). Ask also for interesting and instructive booklet on the use and operation of Amplifying transformers.

Type A-2 Acme Amplifying Transformer
Price $5 (East of Rocky Mts.)

ACME
for amplification

"RASCO HAS IT!"

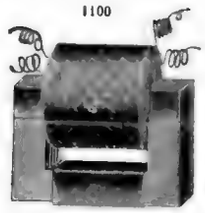
THE Radio Specialty Co.—"Rasco" for short—is probably the most unique supply house in the United States, if not in the world to-day. This company makes a specialty of small orders, no order being too small to get immediate and prompt attention for the simple reason that most of our orders are small.

The reputation of this house was built upon service. Ask any of your acquaintances what they think of Rasco goods, Rasco service, Rasco promptness! Thousands of unsolicited testimonials on file to prove that we serve the public best!

Be sure to get our great catalogue, containing several hundred different parts, which is illustrated h

ORDER DIRECT FROM THIS PAGE. ALL GOODS SENT PREPAID IN 24 HOURS

1100



"RASCO" AUDIO FREQUENCY TRANSFORMER

We have compared many of the present transformers on the market but have finally decided upon a type that is the most efficient one we have seen so far. The best amplifying transformer is that in which the impedance of its primary is equal to or exceeds the impedance of the plate-to-filament circuit of the tube in which it is connected.

We guarantee this transformer to equal any one on the market.

No. 1100 "Rasco" Audio Frequency Transformer (not assembled) each prepaid.....$2.65

ANTENNA CONNECTOR

This antenna connector is made entirely of aluminum, is light and will not rust. The only connector of its kind. The 4 antenna wires go to the upper holes; the lower hole takes the lead-in. Don't solder your aerial, don't have loose connections. Dimensions 2" high, 1¾" wide, ⅝" thick.

No. 999, Connector, each..$0.35

999

PANEL KNOBS

6241

838

No. 6241 is well made and has a good corrugation. Its dia. is 1", height is ½", hole 5/32". The shank is ¼" high.

No. 6241, Knob, each.....$0.08

MARCONI KNOB

Has a central hole of 5/32" and seat to hold the screw, dia. is 1¼", height ¾".

No. 838, Marconi Knob, each.....$0.15

RASCO POSTS

202 201

630 629

These are our very own patterns, from our own designs and look mighty handsome on any instrument. The top knobs are of composition, the bottom parts brass nickel plated polish.

650 651

No. 202 is nickel plated at bottom part.

"Rasco" Binding Post, 8/32 thread, each, $0.10; doz., $1.00.

No. 202, Post, each, ...$0.08

Nos. 650 and **651** made entirely in composition with a hexagonal brass nut in center.

No. 650 has 8/32 machine screw.

No. 651 has bottom wood screw.

No. 650, Post, each.....$0.08

No. 651, Post, each.....$0.08

Dozen, each style.....$0.90

BRASS NICKEL POSTS

No. 029, Binding Post, each.....$0.05

No. 630, Binding Post, each.....$0.04

RASCO SWITCH POINTS

75 1 2 3 4 5 6 7 77 76

Nickel plated and polished. The following have been found the most popular.

No. 1 ¼"x¼", 6/32 thread, ea., $0.03; doz., 35c

No. 2, 3/16" high, ⅛" dia., 6/32 thread, ea., $0.03; doz., 35c.

No. 3, 3/16" x 3/16", 4-36 thread, ea., $0.03; doz., 35c.

No. 4, ¼" dia.; ⅛" thick; stem 6/32, ea., $0.03½; doz., 40c.

No. 5, ¼" dia., 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c

No. 6, 3/16" dia.; 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c.

No. 7, 3/16" dia.; ⅛" thick; stem 4-36, ea., $0.03½; doz., 40c.

No. 75, Switch Stop, ⅞" long, 4-36 thread, complete with nut, ea., $0.05; doz., 50c.

No. 76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼"; dia., 1/16" thick, ea., $0.03½; doz., 40c.

No. 77, same as above, but head is ¼" dia. x 3/16" thick, ea., $0.03½, doz., 40c.

1898

THE RASCO BABY DETECTOR

In presenting this little Detector, we feel sure that it fills a place never taken before by any small detector. It does a variety of things and does them all well and better than many $5.00 detectors. The base is solid, black composition. Mounted on same is a nickel holder and binding post which holds a fluted hard rubber knob with its sliding rod member.

The outstanding part of the Detector, is the patented nickel detector cup and binding post. The knurled cap unscrews and you place the Galena Crystal in the cup, then replace the knurled cap and the galena crystal is held secure. The circular hole in the cap exposes enough of the crystal for ordinary purposes.

No. 1898, Rasco Baby Galena Detector. Price, prepaid.....$0.50

No. 1899, Rasco Baby Detector with Galena and Radiolcite Crystals. Price, prepaid.....$0.75

PANEL SWITCH LEVER

New style switch lever with lock fork. It is impossible for this lever not to make positive contact at all times. The blade radius is 1¼". Blade is nickel plated and polished. Fork is phosphor bronze. The lock fork holds the screw (in which it rotates), securely. A loose contact is impossible.

200

No. 200, Switch Lever, complete as illustrated..$0.30

LITZ WIRE

323

This wire is recognized as the only thing for winding coils for Radio instruments. Particularly recommended with our No. 343 Variocoupler Rotor, for vario-couplers, banked windings, etc.

No. 323, Litz Wire, 20 No. 38 strands, enameled double silk wire, per foot, $0.02; per 100 feet, $1.15

No. 890, Litz Wire, 10 strands No. 38 wire, per foot, $0.01; per 100 feet, $0.75.

No. 891, Litz Wire, 16 cables of three strands No. 38 wire, per foot, $0.03; per 100 feet, $2.25.

NOTE: This page contains only a few of our 300 specialties.

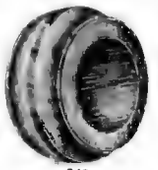
PANEL KNOB

This is a very distinctive knob and can be used on dials, panels, switches, condensers, etc. It is exceptional and well made. Dia. 1 1/16"; height 11/16"; comes with 8/32" bushing.

No. 815, Knob, each.....$0.18

815

VARIOCOUPLER ROTOR



343

This rotor is used by all up-to-date amateurs. Is accurately turned of hard wood and is used as a secondary coil. It takes any finish, either shellac or stain and can be drilled readily for any size hole. Large hole 2" dia. Width of spool is 2". Total dia. 3⅜".

No. 343 Variocoupler Rotor, each.....$0.75

"RASCO" NAME PLATES

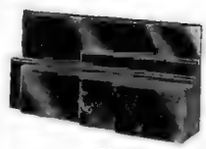
827

839

Our name plates are of brass with a black background. Letters are polished nickel. Order by name and number.

	Each		Each
807 "Phones"	$0.05	810 "Ground	$0.05
809 "Aerial"	$0.05	812 "Primary"	$0.05
811 "Secondary"	$0.05	814 "Detector"	$0.05
813 "Audion"	$0.05	866 "On"	$0.05
865 "Off"	$0.05	840 "Increase Current" (Left)	$0.10
839 "Increase Current (Right)	$0.10	834 "Series"	$0.05
813 "Vacuum Tube"	$0.05	830 "Receive"	$0.05
831 "Transmit	$0.05	820 "2nd Step"	$0.05
821 "3rd Step"	$0.0	827 "Tickler"	$0.05
819 "1st Step"	$0.05	825 "Plate Variometer"	$0.05
826 "Grid Variometer"	0.05	835 "B Battery"	$0.05
823 "Secondary"	$0.05	817 "Output"	$0.05
836 "A Battery"	$0.05	824 "Primary Condenser"	$0.05
818 "Input"	$0.05	828 "Parallel"	$0.05
829 "Telephone"	$0.05	837 "+ —"	$0.05
833 "Detector Tube"	$0.05	841 "(Blank) "(takes pen or pencil writing)	$0.05
822 "Coupling"	$0.05		
808 "Load'g Coil	$0.05		

Price of all of our name plates in dozen lots, 50c, with the exception of the two "Increase Current"



350-55

BAKELITE PANELS

We list below six panels, the sizes of which have been selected after carefully checking up many dimensions of the most popular radio apparatus on the market.

Note particularly that our prices are anywhere from 25 to 50% lower than those quoted by most other concerns. The reason is that we buy these panels in very large quantities, **and we do not cut sheets to order.** Remember always that when sheets are cut to order they cost you at least 50% more than our prices, because **you must pay for the cutting and the necessary waste.**

Note also that we ship these panels prepaid. This alone amounts to a considerable saving.

No. 350	6"	x 12"	x 3/16"	thick, each		$1.90
No. 351	6"	x 18"	x 3/16"	"	"	2.85
No. 352	9"	x 12"	x 3/16"	"	"	3.00
No. 353	12"	x 18"	x 3/16"	"	"	5.65
No. 354	6½"	x 19½"	x 3/16"	"	"	3.50
No. 355	6"	x 7½"	x 3/16"	"	"	1.20

"RASCO" LUBRICATED PANEL SWITCH

1921

A radio switch that has two nuts at the end is a monstrosity, for the reason that it will never stay put. Our patent spring fork holds the switch handle always under uniform tension, at the same time it insures the best contact possible. **New wiping contact,** which covers every point of the switch point. Another new improvement is the lock fork, which can assume three different positions to accommodate the switch to various thicknesses of panels.

No. 1921 "Rasco" Switch, as illustrated, each **$0.50.**

KNOBS

199

4451

These knobs are favorites with all experimenters The size of both is: dia. 1½", height ⅝". No. 4451 comes with 8/32 and 10/32 bushing.

No. 4451, Knob, each...$0.06

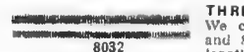
No. 199 (screw length ⅝") Knob, each $0.10

NAVY KEY KNOB

748

This navy key knob is now used on all standard wireless keys. It gives the right swinging motion and rests the fingers. It is a favorite with all advanced amateurs. Once used always used. The screw is 8/32 and will fit all keys.

No. 748, Key Knob, each.....$0.28



8032

THREADED BRASS ROD

We carry two styles, 6/32 and 8/32 thread. **Only 6" lengths sold. No others.**

No. 8032, Threaded Brass Rod 8/32 thread, per 6" length $0.08

No. 6032, Threaded Brass Rod, 6/32 thread, per 6" length $0.06

THE "RASCO" CATALOG

CONTAINS 50 VACUUM TUBE HOOK-UPS

Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few. —The V.T. as a detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; etc., etc. The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

15c in stamps or coin.

Radio-Specialty-Co

This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. Order from the above illustrations. "We can only stick you once." Try us with a 50c order. ALL GOODS PREPAID.

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Factories Brooklyn, N. Y.—Elkridge, Md.

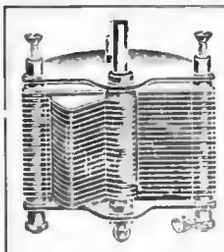
$4.90

A REAL RADIO

A highly improved Crystal Receiving Set, insuring very fine tuning. Extremely practical for amateurs as well as professionals. Receives radio messages and music within a radius of 25 to 50 miles. Not a toy. Compares with the best crystal sets made. Complete except aerial wire and receivers. We can furnish best 3000 ohm receivers if desired at $10.00 extra. Send for it today at the special introductory price—$4.90 prepaid.

All orders receive prompt attention.

THE TAVEL RADIO COMPANY
721 Cass Avenue. Detroit, Mich.



"STANDARD" VARIABLE CONDENSERS

Excell through substantial mechanical construction, show even calibration curve, low resistance and low lead di-electric loss.

11 Plates, Cap'y	.0025 + M. F.	$2.35
23 " "	.0005 + M. F.	2.85
43 " "	.001 + M. F.	3.60
83 " "	.0015 + M. F.	5.50

Hard Rubber Graduated Dials, 3" 75c. 4" 1.00
Variometers wired and assembled 3.00
Sockets, single, $1.00; double, $1.75; tripie, 2.40

"STANDARD" IMPROVED RHEOSTATS

A departure from the customary design. Will not cause noise in the receiver. Resister cannot come loose. Price with knob and pointer $1.00.

We ship, postage prepaid, upon receipt of price.

All "Standard" products Are Fully Guaranteed.

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Send us your requirements for prices

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One Union Square New York City

Book Review

(*Continued from page 503*)

cine ball and general apparatus. But instead of exercising the muscles of his eyes, he takes great care of them, sparing them every exertion and strain, and doing his best to reduce their power of accommodation, and undoubtedly in many cases, injuring them by the treatment or rather absence of treatment which he gives them. Gradually people are awakening to the idea that the defective eye may be improved by proper exercise of his muscles and by simple manipulation applied by the skilful hand. The illustrations in the book present examples of wonderful work done by Dr. Bates' methods. There are many people wearing glasses, who would be much better without them. But in many cases there is danger that the eyes have been permanently injured by dependence on the weakening lenses of the spectacles and eye-glasses. We advise those who think of adopting eye-glasses to read Dr. Bates' interesting treatise.

ELECTRICAL WORKERS' FRIEND. By J. A. Smith. Second Revised Edition. Cloth covers, 5" x 7½" 79 pages. Published by Smith & Smith Publishing Co., Pittsburgh, Pa

A most practical set of diagrams, eighty in number, with a data sheet printed on the back of seventy of the diagrams, the whole mounted in loose leaf style, tells how to wind stators and rotors. A certain amount of text is given first, with accompanying diagrams and the arithmetical calculations required, and after some fifteen pages of this more general matter, page after page of winding diagrams follow

PREPARED RADIO MEASUREMENTS. By Ralph Batcher, E. E Cloth covers, size 6¼" x 9". 138 pages Published by Wireless Press, New York City

It is one thing to buy a $20.00 radio receiving set, put it up in your parlor, listen to jazz music and various phonograph records on week-day evenings and to sermons and alleged sacred concerts on Sunday evenings, and another thing to build an intelligently constructed sending and receiving station with proportions, capacities, and inductances properly calcuiated and distributed. Mr. Batcher in the introduction says in the first sentence, that a large amount of radio equipment is constructed by amateurs with the cut and try method, and even the commercial and engineering fields are not free from those who use this method. But to go at radio work scientifically requires considerable knowledge of the higher mathematics. The present work substitutes charts for mathematics, the said charts to be solved by the use of a straight-edge or rule. It is the last simplification of graphic methods for getting mathematical results. Graphical solutions are not always to be recommended. They sometimes are the lazy man's way of attaining a result. But the methods here given are quite admirable, and we would like to see them applied in other fields.

THE AIRLINER AND ITS INVENTOR, ALFRED W. LAWSON. By Cy. Q. Faunce. Illustrated. Cloth covers, size 6" x 9¼". 206 pages. Published by Rockcastel Publishing Co Columbus, Ohio

An aspect of advertising Mr. Lawson's achievements and views seems to permeate this production, but the illustrations are so very interesting and even the personalities of the book, including a picture of a man shaving himself in a moving airship, give it interest and perhaps real value. Mr. Lawson's prophecies, whose detail kindly stops with the year 10,000 A.D., tells of all sorts of wonderful things that man will do, and gives us the comforting conclusion that after 10,000 A.D., man will begin to develop in real earnest. There is no index, but we hardly think one is needed.

CONTEMPORARY SCIENCE. By Benjamin Harrow, Ph.D. Flexible cloth covers: size, 4"x6½". Published by Boni and Liveright, New York

This is a very attractive little work. It is a collection of papers by the highest authorities on twelve important divisions of natural science. Irving Langmuir, Sir Charles Parsons, Simon Flexner, figure among the authors, so it is evident that the compact little book certainly contains the highest class of scientific literature. Very properly, Einstein's Law of Gravitation, treated by Prof. J. S. Ames of Johns Hopkins University, is the concluding chapter. Dr. Benjamin Harrow is daring enough to give a brief chapter on enzymes and really tells a good part of their story in eight or nine pages. From the Rockefeller Institute Dr. Jacques Loeb gives a treatise on the natural death and the duration of life. Prof. W. W. Keen gives a paper composed of two of his lectures on surgery and medicine before and after Lister taught the doctrine of cleanliness in surgery. We cannot commend this little book too highly, although we have noticed several misprints.

No Wireless receiving set is complete without the MAGNAVOX Radio
WHEN the club House Committee meets again, be sure to propose the installation of a wireless receiving set.
If equipped with MagnavoxRadio(the reproducer supreme) the club, lodge, hotel or home wireless station will furnish everybody the best of dance music, concerts, market reports, world news events and entertainment—something or other going on almost every hour!
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Radio brings it, MAGNAVOX tel's it

ELECTRICAL EXPERIMENTERS!!

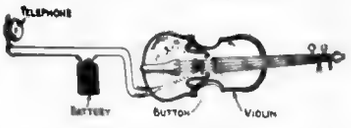
SKINDERVIKEN TRANSMITTER BUTTON

MOST SENSITIVE MICROPHONE

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

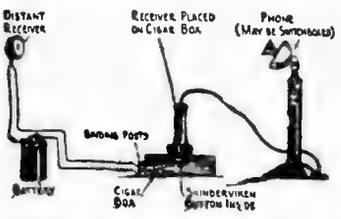
You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *This outfit was used by secret service operatives during the War. It is being used on the stage.*

So much for its commercial adaptations! *You* can procure apparatus of the same type.



One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in microphones and has won recommendations from men of high standing in the scientific world It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



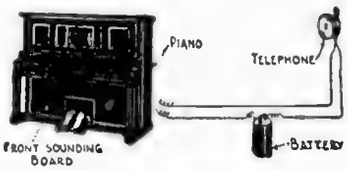
AS A PREMIUM

Actual size.

MR. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

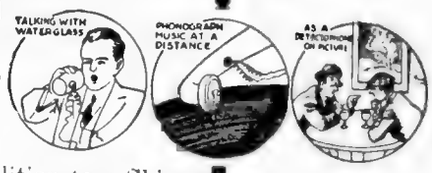
The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.



We have acquired a limited amount of these Transmitter Buttons and offer same free to our subscribers as a Premium, with a one year subscription to SCIENCE AND INVENTION. These Buttons sell everywhere for $1.00 and are worth it. We send you one prepaid upon receipt of the coupon below and the subscription price of our magazine. Do it today.

—o—



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S. I. 9-22

The Slot-Machine Radio

By H. GERNSBACK

(*Continued from page 442*)

As for the slot-machine operation, this is accomplished as follows: For an entertainment of this kind we may assume that 25 cents for a duration of two hours would not be too much, and would not be objected to by the user of the machine. A hotel guest, let us say, consults his paper and finds out that a certain station is sending, at 8:00 P. M., an entertainment in which he is interested. He puts the quarter into the slot, and for 25 cents he gets a two-hour entertainment. A clock dial is shown on the face of the instrument, and this operates in such a manner that it automatically cuts off the circuit when the second hour is reached. The user, by looking at the clock, can see how long the entertainment will last; then, if he wishes to have more than two hours, a new payment is to be made.

Contrary to popular belief, a machine of this kind is not very expensive, and if produced in quantities it is possible to manufacture such an instrument for $100.00 or less.

A slot-machine radio outfit, as here described, is one way of purveying radio entertainment to the public, and when it comes to hotels there is another method which might be found very desirable, especially in the better class of hostelries; namely, to make a slight extra charge on the price of a room, where the radiophone is to be used, and either a special key to unlock the main radio circuit switch could be furnished the guest when he registered at the hotel, or the sets might be locked and unlocked electrically from the clerk's desk.

No doubt, this radiophone instrument will later be arranged for carrying on wireless conversation with subscribers in other cities, when the radio telephone comes into use.

COLUMBIA RADIO PARTS

Price, **$5.50**
With Dial, **$6.50**

COLUMBIA MOULDED VARIOMETER

A *superior* instrument with the Stator and Rotor of *moulded hard rubber*. Accurate electrical and mechanical construction throughout; designed for *best values of maximum and minimum inductance* and minimum distributed capacity. Has 3/16" shaft, with spring tension to secure electrical contact. Adapted for both base and panel mounting. All metal parts highly nickeled. An essential radio instrument of beauty and efficiency.

COLUMBIA 180° MOULDED VARIOCOUPLER

A MOST efficient 180° coupler designed for sharp tuning from 150 to 650 meters. Stator made of a highly dielectrical composition. Rotor of *moulded* hard rubber: both wound with green silk covered wire. All metal parts nickel plated and mechanically correct. Ten taps are provided. Has 3/16" shaft with spring tension to insure electrical contact; base and panel mounting.

Price **$5.00**
With Dial **$6.00**

Columbia Apparatus will add beauty and efficiency to your outfit. **Variable Condensers,** 23 plate, **$3.50**; 43 plate, **$4.50**. **Bakelite or Hard Rubber Dial and Knob, $1.00.**

If your dealer does not stock our items, send your order direct

COLUMBIA RADIO CORPORATION

2756 Diversey Avenue
Chicago Illinois

Now Ready!
The DICTOGRAPH Radio Loud Speaker *for the Home*

THE Radio public has been waiting for the Dictograph Radio Loud Speaker. Perfected by Dictograph Products Corporation, the pioneer manufacturer of loud-speaking telephones, and world-famous for its sound-transmission instruments; the same supreme quality as other Dictograph products.

Years of experience have made possible this new Loud Speaker—**the best in the world**—and sold at a price that gives you DICTOGRAPH quality at no extra cost. The great, assured demand has made possible a reduction from the price originally announced. Instead of $25, it is only **$20—complete with 5 ft. flexible cord.**

See the Dictograph Loud Speaker at your dealer. Dealers can be supplied by local jobber—or inquire direct.

Price **$20**
Complete with 5 ft. flexible cord

The Standard of the World

DICTOGRAPH Radio HEAD SET

Ask for the Dictograph Head Set—**the best Head Set in the world, regardless of price.** The name Dictograph is your guarantee of supreme quality. It insures the most sensitive and accurate transmission of sound known to Radio.

The Dictograph Loud Speaker is beautifully constructed; the cabinet is of hardwood, ebony finished, with die cast black enameled aluminum tone arm. The horn is spun copper, highly polished. French lacquered, non-tarnishable. Completely equipped with 5 ft. flexible silk cord. For any vacuum tube receiving unit. No extra batteries required.

DICTOGRAPH PRODUCTS CORPORATION

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YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

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Boys get flying model aeroplane free. Write to Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

Agents Wanted

Agents Wanted in every city and town to sell standard radio apparatus. Attractive discounts given. If interested, write us at once stating age and radio experience. Wilmington Electrical Specialty Co., Inc., 912 Orange Street, Wilmington, Delaware.

Live Agents make $10 Day selling Eureka Strainer and Splash Preventer for every water faucet. Takes on sight. Widely advertised and known. Get details today. A. J. Seed Filter Company, 73 Franklin, New York.

A Business of your own—Make sparkling glass name plates, numbers, checkerboards, medallions, signs; big illustrated book Free. E. Palmer, 513 Wooster, O.

Agents—Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

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Agents, $60 to $200 a Week, Free Samples. Gold Sign Letters for Store and Office windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 433Z N. Clark St., Chicago.

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Earn big money fast applying gold initials to autos. Every owner buys—$1.35 profit on $1.50 sale—particulars and samples free. Write quick. Lithogram Co., Dept. 19, East Orange, N. J

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Complete Selling Outfit Free. Take orders for Goodyear Guaranteed Raincoats from pocket size Style Book. Better goods. Lower prices. Big Saving by selling direct makes sales easy. No experience needed. Quality, Price and Styles get the orders. Write Quick. Goodyear Manufacturing Company, 1927-C Goodyear Building, Kansas City, Mo.

We wish representatives in every community to secure subscriptions for Science and Invention, Radio News, and Practical Electrics. This is a wonderful opportunity for Amateur Radio Enthusiasts to make big money quickly. Write Experimenter Publishing Co., Inc., 53 Park Place, New York City.

Great Profits Assured capable men joining immediately national organization for Evenflo Self-filling Ink-pencil Pen. Writes with ink instead of lead. Send for Profit Proposition. Evenflo Pen Company, Dept. 63, Grand Rapids, Mich.

Ambitious men, write today for attractive proposition, selling subscriptions to America's most popular automobile and sportsman's magazines. Quick Sales. Big profits. Pleasant work. Digest Pub. Co., Butler Bldg., Cincinnati, Ohio.

Agents—Here is your opportunity to own an independent business distributing high-class household specialties that repeat. Stamp brings valuable information. Dwyer Mfg. Co., 16 Hawkins St., Somerville 42, Mass.

Big Earnings and Steady Repeat Business assured agents selling to women and homes, finest, most complete line toilet preparations and specialties. Sure Success Plan. Get details today. Colonial Chemical Company, 631-0. Penn Avenue, Pittsburgh, Pa.

$10 a Day and More, our new book, shows clearly how you may gain sure success and large profits selling Guaranteed Hosiery and Underwear factory to family. It is Free. Write today. C. & D. Company, 37-E Grand Rapids, Mich

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300% profit: Whirlwind Seller. Klean-Rite. New Washing Compound. No Rubbing. Premiums for Customers. Samples Free. Bestever Products Co., 1945-Z Irving Park, Chicago.

Agents—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent.; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., Dept. 601, Philadelphia, Pa.

Agents Wanted (Continued)

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Sales Representative wanted in every county to give all or spare time. Position worth $1,200 to $3,000 yearly. No previous experience or capital necessary. Write for full particulars. A. F. Silver-Chamberlin Co., Clayton, N. J.

Agents—Snappiest Household Line on Earth, Red Hot sellers, steady repeaters, 100 per cent. profit. 350 light weight, fast selling, popular priced necessities. Agent's Outfit Free. Get busy—quick. Write today; postal will do. American Products Co., 7763 American Bldg., Cincinnati, Ohio.

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We want men and women who are desirous of making $25.00 to $200.00 per week, clear profit from the start in a permanent business of their own. Mitchell's Magic Marvel Washing Compound washes clothes spotlessly clean in ten to fifteen minutes. One hundred other uses in every home. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Free samples make sales easy. Enormous repeat orders—300 per cent. profit. Exclusive territory. We guarantee sale of every package. Two other "sight sellers" and sure repeaters give our agents the fastest selling line in the country. No capital or experience required. Baker, Ohio, made $600 last month. You can do as well. Send for Free Sample and proof. L. Mitchell & Company, Desk 79, 1302-1314 E. 61st, Chicago, Ill.

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Automobile Mechanics, Owners, Garagemen, Repairmen, send for free copy America's Popular Motor Magazine. Contains helpful instructive information on overhauling, ignition wiring, carburetors, batteries, etc. Automobile Digest (9541) Butler Bldg., Cincinnati.

Start! Auto Top Building—New invention—Particulars Free. Address Schives, 19 So. LaSalle St., Room 1229, Chicago, Ill.

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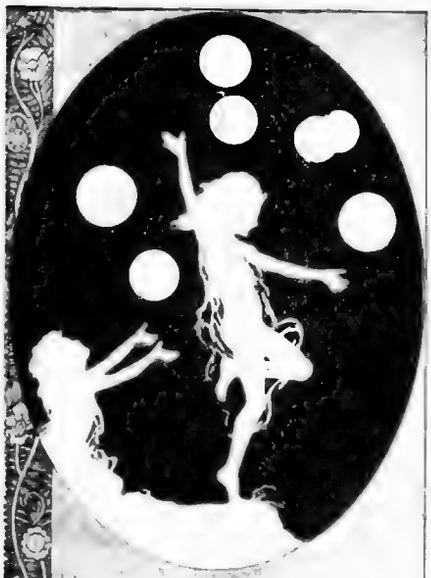

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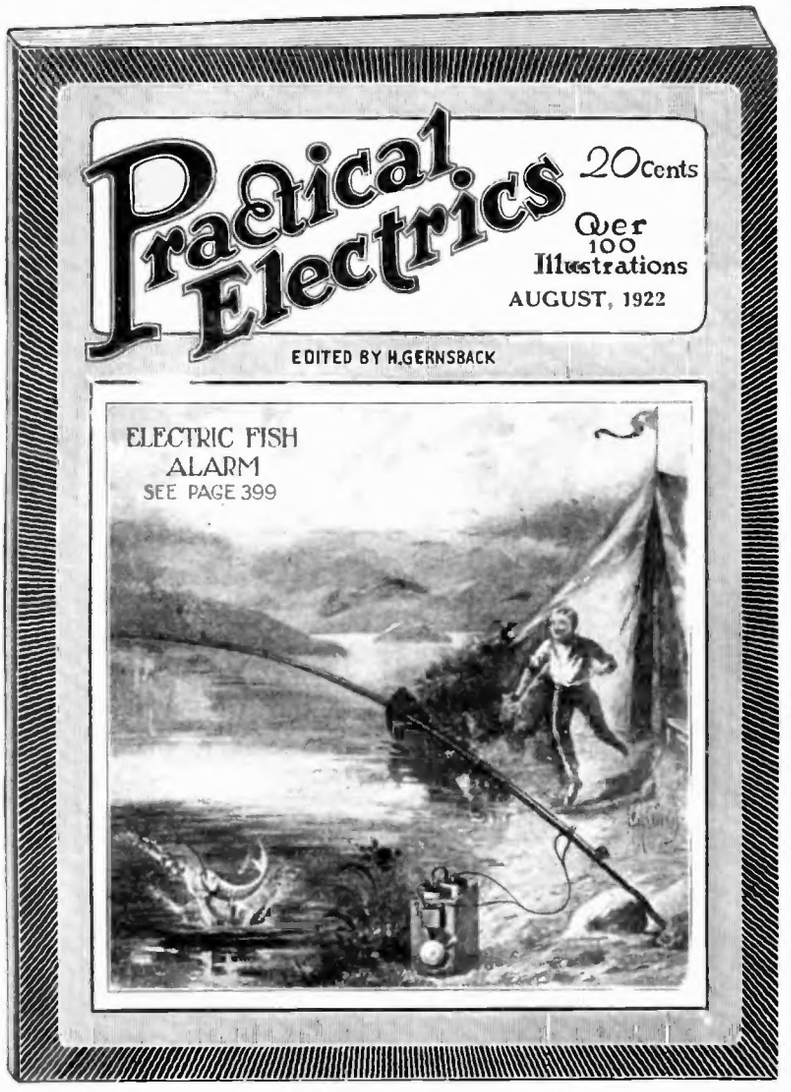

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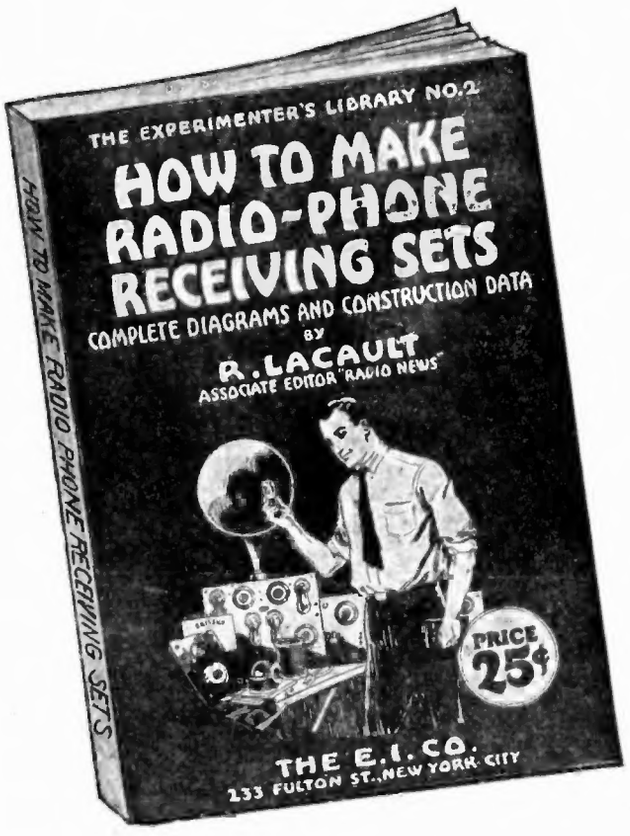
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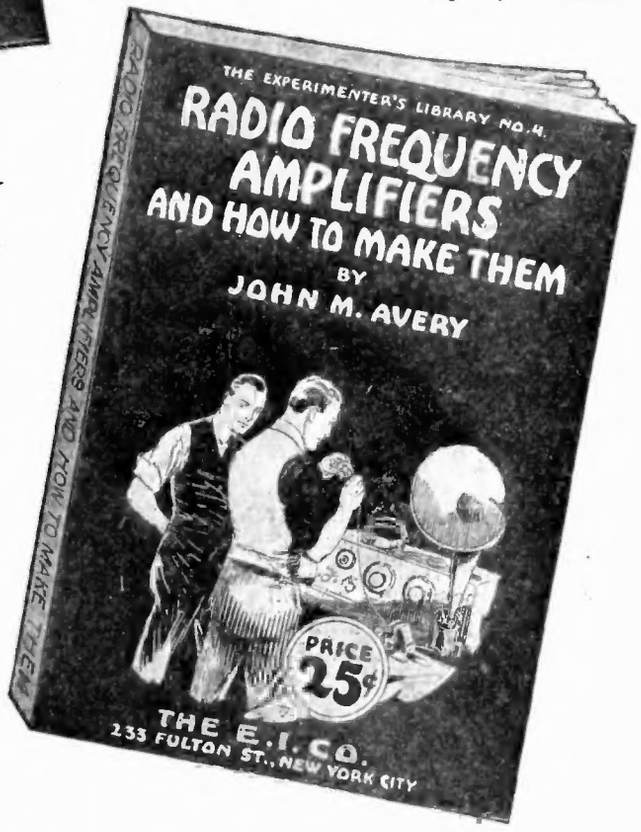
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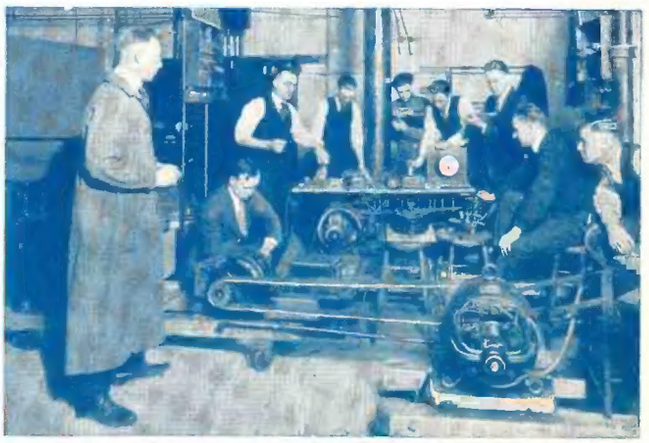


How America's Greatest Institution of Electrical Education Makes You an Expert Quickly—Ready to Step Right Into a Big Pay Job

THE other day a young man, smartly dressed, with the firm step and keen eye that is always a part of the highly successful man, stepped up to the desk of the Registrar of this great school. After warm greetings, for this young fellow was a graduate of the school, a story of his quick rise after graduation followed with the request that a place be reserved in the Fall Term for his younger brother.

This young man had a few years back come to the United States from South America. He wanted to learn electricity in all its phases—to become an electrical expert. Before selecting a school, he thoroughly investigated them all. He attended classes, examined their laboratory equipment and looked up the records of their graduates.

He finally chose the School of Engineering of Milwaukee, because as he said: "There is really no other school like this. Your immense laboratories with every conceivable piece of electrical equipment, the large and wonderful staff of expert instructors, the general air of thoroughness about doing everything here is incomparable. The minute detail with which you treat every phase of electrical work, makes your graduates **real experts** ready to cope with any situation out in everyday work, thereby fitting them to hold important jobs right after they leave school. In my work back home, I have never met a problem that had not already been mastered at the school and some mighty hard ones have arisen many times. I owe my success entirely to my splendid training here. That's why I am bringing my brother to you."

For over **17 years** the School of Engineering of Milwaukee has been training men for brilliant careers in all branches of electricity. This great institution is devoted exclusively to practical electrical education and offers advantages to be found nowhere else. There are large laboratories filled with thousands of dollars worth of motors, generators, switchboards, meters, testing instruments, apparatus and electrical equipment, etc., etc., all working size—not just models—with which the students daily learn in actual practice every angle of this fascinating work. Both theory and practice are taught so that every graduate is ready instantly to fill a high salaried position.

Never Greater Opportunity Than Now

The electrical industry has developed so rapidly within the last few years, that today there is a great shortage of trained specialists qualified to fill with credit the many splendid positions open every day. The requirements constantly become more stringent, so that in order to make good today, a man must **have special training.** And the wise young man is he who comes to this great electrical school, learns electricity thoroughly and then steps into a fine paying job.

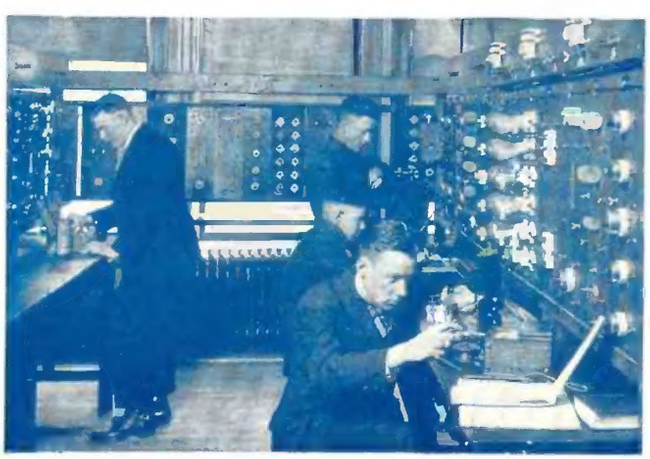
No matter what your age or what your previous education has been, the School of Engineering of Milwaukee can and will make you an expert in electricity. That is perhaps the most popular feature of the system of training employed only by this famous institution. It strives to take care of every ambitious man in the way best calculated to fit his ability and means. You may take a short, intensive, specialized course or you may take a long general course, as may seem best for you.

Choose the Branch That Interests You Most

The man who makes good money today is the one who **specializes!** That is why this school first gives a student a quick, intensive training in the general theory and practice of the principles of electricity and then trains him for whatever branch of the work in which he desires to specialize. He quickly becomes not only a good electrician but also a specialist—ready to earn big money out in the industry. You may become here an Electrical Engineer, an Electrotechnician, a Practical Electrician, Motor Generator Maintenance and Repairman, Electrical Draftsman, Automotive Electrical Expert, etc., etc.

Spend Just the Length of Time Here You Desire

Our long experience has taught us that many young men want to come in for a short time to learn an electrical trade so that they can get into electrical work immediately. To care for these knowledge seekers, we have provided a series of intensive short Shop Courses which are thoroughly practical and quickly mastered. COURSE I makes an Expert in Electric Light Wiring and Testing; learn in 3 months. COURSE II covers Armature Winding for A. C. and D. C. Motors; learn in 3 months. COURSE III combines Electric Light Wiring, Testing and A. C. and D. C. Armature Winding and takes 6 months time. These courses are very popular. They cover 8 hours class work each day, five days a week.



Automotive Electrician—Master this work in 3 months. A complete and thoroughly practical course that fits a man to repair and reconstruct any electric starting and lighting system, ignition, storage-battery, for an automobile, auto truck, tractor, motorcycle, motorboat, airplane, etc. This is one of the most profitable fields of work, many men in it making splendid incomes in their own shops, service stations, or garages.

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Practical Electricity—Learn in 6 months. Gives the student both the principle and practice of electricity. This course covers every phase of electrical work, fitting the student to start in business for himself as an expert electrician or electrical contractor.

Electrotechnic—A course of 1 to 2 years. Makes you an expert Electrotechnician—the man who fits electricity to modern industry. This fascinating course gives you a practical training that leads to such positions as Superintendent of Maintenance, Director of Construction, Radio Engineer, Superintendent of Testing and Installation, Electrical Equipment Salesman, etc. Every one of these positions pay handsome salaries.

Electrical Engineering—Learn in 3 years, with B. S. Degree. With this training, you may quickly take your place with the leaders in the industry. Many of the graduates of this school now occupy places of great honor and high incomes. Yet the field is less crowded than in any other profession.

The Helping Hand We Lend You

Young men coming here find always a sympathetic, conscientious atmosphere, a desire on the part of the principals of this school to help every one to accomplish his ambition. Milwaukee is a busy, thriving industrial city, filled with opportunity for the aggressive young man who must work in spare time to defray his expenses. The leaders of industry here are ever ready to help the conscientious, deserving young man who develops himself through education in this great school to make a mark for himself in the world. Write at once for complete details of how this plan works.

Your Passport to Success

is the coupon below. Send it at once to get our illustrated catalog and complete information about this wonderful school. Mention the branch of electricity in which you are most interested. In fact, we suggest that you write us all about yourself, so that we can advise you in detail of the steps you should take to accomplish your ambition. Don't put off! Every hour cheats you of the power to earn more money, keeps success just that much longer away from you!

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Gentlemen:

Within the very near future we will likely require the services of a Radio Operator at our general office here and one at our Sullivan Pond Creek Operation, Stone, Pike County, Kentucky.

Young men—21 to 24 years of age are preferred. Should you have students or ex-students who would likely be interested, kindly have them make full application promptly, and oblige.

Yours very truly,
J. C. SULLIVAN.

DAVIDSON AND COMPANY,
Hartford, Conn.

National Radio Institute,
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Gentlemen:

One of our clients interested in the manufacture of Radiophone receiving sets is about to start a factory, eventually employing about 1,000 hands.

We have been asked to secure for them a man familiar with Radiophone and capable of employing, organizing and directing a large force of people.

We would expect this of this man: that he could make four walls and develop a money-making industry.

He will have advisory and financial cooperation.

Salary will be commensurate with ability and the right man would also be given an interest in the business.

No capital is required.

This plant should also be able to furnish positions for other of your graduates.

Kindly advise if you are interested.

Very truly yours,
DAVIDSON & COMPANY. INC.

NEW HAVEN RADIO COMPANY,
New Haven, Conn.

The National Radio Institute,
Washington, D. C.

Gentlemen:

We are asking a little favor of you confidentially, in the submitting to us, in the self-addressed envelope enclosed, the name of a high-grade Radio salesman, in whose hands we can confidently entrust the representation of our company.

We are sure that you know of such a man, and we hope that you will find time to give us his name, or have him write us, directly, a little letter submitting his credentials, upon receipt of which we will be glad to make a mutually interesting and profitable connection.

Very truly yours,
MARSHALL BEYMER,
New Haven Radio Co.

UNIVERSAL RADIO COMPANY,
Pittsburgh, Pa.

National Radio Institute,
Dept. 1082, N. W., Washington, D. C.
Gentlemen:

Seeing your ad in several magazines, we thought you would be in a position to cooperate with us in securing men with executive ability as well as knowledge of the Radio business to take charge of our offices as local managers. Next in importance to the qualified office manager would be the installation men, upon whom we would have to depend largely for our success.

We would expect to pay both the office managers and the installation men $200.00 per month for the balance of this year. And every one that produced sufficient business to justify, we would willingly and gladly advance the first of January, 1923.

Yours very truly.
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You Can Get Jobs Like These in Radio

GET into Radio, the new profession of wonderful opportunities! Radio is a gigantic six-billion-dollar industry—and growing bigger every day. From land and sea comes the ever-growing call for more men trained in Radio—to supply the demand for designers, operators, mechanics, installation men, technicians, engineers, salesmen, etc. Thousands of splendid, big-pay positions are waiting to be filled by ambitious men. Every day we get letters like these shown here from employers of Radio men, asking us to send them our students and graduates to fill the positions they have open.

Here is your greatest opportunity for fortune and success. Take advantage of it. Radio wants YOU NOW! The field is uncrowded. Jobs are literally going begging for competent, trained Certified Radio-tricians. The work is fascinatingly easy. You start at a splendid salary and in a few years you may fill one of the positions that pay up to $10,000 a year.

Become a Certified Radio-trician©

The National Radio Institute, America's first and largest Radio School, will quickly qualify you in your spare time at home for the job you want in Radio. Already it has taught over 10,000 students, hundreds of whom today hold wonderful positions at better pay than they ever had before.

Learn at Home in Spare Time

Use your present Radio knowledge to help you win success in this great field. The National Radio Institute will complete your Radio training quickly at home, and enable you to qualify for a Government First Grade license, so you can take your place in the Radio profession in the shortest possible time: Four wonderful, patented instruments are furnished you free for practical work at home in Radio operation, maintenance, installation and repair. Among them is the famous Natrometer which helps you to quickly acquire expert speed and accuracy in sending and receiving code. Famous Radio experts will instruct you—give you the benefit of their knowledge and experience—help you in every way to quickly become a successful Certified Radio-trician.

Radio Knowledge Worth Big Money

Don't be satisfied with making a hobby of Radio. Make it your life's profession. Don't let the other fellow beat you to the wonderful positions now waiting. Your Radio-Knowledge is worth big money. "Cash in" on it—Big!

Thousands of men with no knowledge or experience now are preparing for wonderful careers in this great profession. Will you allow these beginners to get ahead of you? Will you let them get all the good jobs while you sit idly by? Will you always be satisfied to be just an amateur, when it is so easy to earn amazingly big salaries doing the easy, interesting Radio work?

Big Book Free

The National Radio Institute is ready to give you the same practical help that has put hundreds of its graduates on the high-way of Radio success. You know something about Radio now. A part of your spare time spent in learning the professional side of Radio will start you on your career in this field of unlimited possibilities. Find out at once about your opportunity in Radio. Send for the interesting big book which tells how the National Radio Institute prepares you as a Certified Radio-trician, and helps you through its Free Employment Service to a good Radio position. Mail the coupon or write a letter now!

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I have opened a Radio Supply House in this town, and am doing a very good business. I also hope to finish my lessons in the near future, as I have but four (4) months left. If I had listened to your instructions, I would have been an operator now.

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I received my diploma O. K. and I am sure pleased with it. Your course is simplicity itself, yet thorough. It has enabled me to fit myself so that I am now employed in one of the largest radio manufacturing concerns of this country, testing all kinds of Radio apparatus.

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Please send me your free book telling how I can become a Certified Radio-trician in my spare time at home, with details about the positions open to me in Radio and how your Free Employment Service helps me get a good position in Radio.

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